

NUCLEAR SCIENCE ABSTRACTS

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ERRATA

NSA, Vol. 8, No. 1, p. 38. In abstract 344, Report NP-4920 should be NP-4920; AD-18886.

NSA, Vol. 8, No. 3, p. 106. In abstract 898, Report NRL-4252 should be NRL-4252; AD-20426.

NSA, Vol. 8, No. 17, p. 635. In abstract 5285, the word centrifuge should be betatron.

NSA, Vol. 8, No. 18A, p. Index-7. In Numerical Index of Reports, cancel the entry "UCRL-2603, 8-4787, Phys. Rev. 94, 1292-9(1954)".

NSA, Vol. 8, No. 19, p. Index-5. In Numerical Index of Reports, Report BMI-931, 0.25 should be 0.20.

NSA, Vol. 8, No. 19, p. Index-7. In Numerical Index of Reports, the abstract number for AECU-1290 should be 5-4134.

GENERAL

ATOMIC POWER

6912

Purdue Univ.

THE APPLICATION OF NUCLEAR POWER TO AIRCRAFT AND ROCKET PROPULSION. Fred W. Bruner. Nov. 12, 1948. 29p. (ATI-47066)

BIOLOGY AND MEDICINE

6913

Radiation Lab., Univ. of Calif., Berkeley

USE OF CONTROLLED PHOTOSYNTHESIS FOR MAINTENANCE OF GASEOUS ENVIRONMENT. James A. Bassham. Sept. 1954. 10p. Contract W-7405-eng-48. (UCRL-2707)

The problem of maintaining livable oxygen and carbon dioxide pressures in a closed space in which men must live leads to consideration of the possible use of the photosynthesis of green algae. A calculation based on the known respiratory rate of man and the photosynthetic rates of *Chlorella* indicates that it would be feasible to use algae for this purpose. (auth)

6914

STUDIES ON CELL DIVISION. NITROGEN COMPOUND CHANGES IN YEAST ACCOMPANYING AN INHIBITION OF CELL DIVISION. Edward Spoerl and Richard Carleton (Mound Lab., Miamisburg, Ohio). *J. Biol. Chem.* **210**, 521-9(1954) Oct.

Growing yeast cells were treated with α particles, x radiation, and triethylenemelamine to inhibit division of the cells so that they enlarged in size. Major nitrogen fractions of the division-inhibited cells were measured chemically, and the free amino acids, amides, and glutathione of the cells were measured by paper chromatography. Increases in total nitrogen and protein nitrogen (TCA-insoluble material) were observed in division-inhibited cells compared to control cells; decreases were observed in acid-soluble nitrogen, amino nitrogen, and, most markedly, in amide nitrogen. Amino acids were affected in different ways. Arginine, histidine, and lysine increased or were unchanged in amount in treated cells; glutamic acid was unchanged; valine, serine, and threonine decreased markedly in amount, as did asparagine and glutamine. When cultures were irradiated at a lower starting cell count, lysine decreased slightly in amount. Other amino acids decreased in amount in any irradiated cells. Glutathione increased in treated cells. Patterns of change caused by the three division-inhibiting agents were quite similar. (auth)

RADIATION EFFECTS

6915

INFLUENCE OF HYDROGEN ION CONCENTRATION ON

RADIATION EFFECTS. Tikvah Alper and M. Ebert (Hammersmith Hospital, London). *Science* **120**, 608-9 (1954) Oct. 15.

The role of oxidation and reduction reactions in radiation injuries to living cells and the influence of pH on these reactions are discussed. (C.H.)

6916

X-RAY INACTIVATION OF SACCHAROMYCES DURING THE BUDDING CYCLE. A. Sarachek (Southern Illinois Univ., Carbondale). *Experientia* **10**, 377-8(1954) Sept. (In English).

The x-ray inactivation of tetraploid yeasts was studied during different stages of the budding cycle. Control interphase cells yield sigmoid multitarget survival curves with an average target value of about 3.5 and a rate of logarithmic inactivation of 0.101. The survival curves of cells throughout the entire budding cycle are exponential. Nonbudding cells show an increased resistance to inactivation; during the middle and later phases the resistance to inactivation decreases. These observations provide additional evidence that the inactivation of yeast cells by x radiation is in large part a consequence of the induction of chromosomal aberrations. (J.S.R.)

6917

A GAMMA-RAY SOURCE FOR STERILIZING INSECTS. E. B. Darden, Jr., E. Maeyens, and R. C. Bushland (Oak Ridge National Lab., Tenn.). *Nucleonics* **12**, No. 10, 60-2 (1954) Oct.

A Co^{60} irradiation unit is described which was constructed for the purpose of sterilizing insects, insect larvae, and insect-infested material. Techniques are described for utilizing radiation in large-scale control of the screw worm, and preliminary results are reported. (C.H.)

6918

RADIOBIOLOGY OF THE C3H MOUSE MAMMARY CARCINOMA. EFFECT OF IMMUNOGENETIC FACTORS ON THE RADIOSENSITIVITY OF THE TUMOUR TREATED IN SITU. A. Cohen and L. Cohen (Johannesburg General Hospital, South Africa). *Brit. J. Cancer* **8**, 303-12(1954) June.

6919

RADIOBIOLOGY OF THE C3H MOUSE MAMMARY CARCINOMA. INCREASED RADIOSENSITIVITY IN SITU OF HOMOPLASTS ATTENUATED PRIOR TO IMPLANTATION. A. Cohen and L. Cohen (Johannesburg General Hospital, South Africa). *Brit. J. Cancer* **8**, 313-19(1954) June.

6920

STUDIES ON RADIOSENSITIVITY AND "IMMUNIZING" ABILITY OF MAMMARY TUMOURS OF MICE. Anna Goldfeder (Department of Hospitals and New York Univ., New York City). *Brit. J. Cancer* **8**, 320-35(1954) June.

6921

THE EFFECT OF TOTAL BODY X-IRRADIATION ON

HEPATIC AND RENAL FUNCTION IN ALBINO RATS.

Kee-Chang Huang, James R. Almand, and Lila A. Hargan (Univ. of Louisville School of Medicine, Kentucky). Radiation Research **1**, 426-36(1954) Oct.

A single dose of total-body irradiation was given to albino rats. Studies indicated that the livers in only three of 63 irradiated rats lost their capacity to inactivate antidiuretic hormone. No morphological change in the liver was observed. Studies on the pre- and post-irradiation renal clearances of 7 male rats revealed a decrease of glomerular filtration rate and tubular excretion in only one animal; one other animal showed a marked fall of glomerular filtration rate with slight decrease of PAH clearance. In the first 12 days post-irradiation, the PAH uptake and Q_{O_2} of kidney slices were lower than that of the daily control. Following that period, both the PAH uptake and Q_{O_2} returned to normal. (auth)

6922

THE EFFECTS OF LOCALIZED CATHODE-RAY PARTICLE IRRADIATION OF THE HYPOPHYSIS AND WHOLE-BODY X-IRRADIATION ON GONADOTROPHIN, THYROTROPHIN, AND ADRENOCORTICOTROPHIN OF THE RAT PITUITARY. G. M. Mateyko and Abraham Edelmann (New York Univ., New York City and Brookhaven National Lab., Upton, N. Y.). Radiation Research **1**, 470-86 (1954) Oct.

6923

THE ACCUMULATION AND DESTRUCTIVE ACTION OF ASTATINE²¹¹ (EKA-IODINE) IN THE THYROID GLAND OF RATS AND MONKEYS. Joseph G. Hamilton, Patricia W. Durbin, and Marshall Parrott (Univ. of California, Berkeley and San Francisco). J. Clin. Endocrinol. and Metabolism **14**, 1161-78(1954) Oct.

A disturbance in the rate of growth in rats and monkeys has been demonstrated following the administration of At²¹¹. This phenomenon has also been seen in rats given I¹³¹. The initial effect upon the growth of the rat following the administration of either I¹³¹ or At²¹¹ at lethal levels may be ascribed to acute radiation injury. The later disturbances in growth appear to be a result of endocrine changes due to lack of the thyroid hormone. The growth pattern in the monkey indicates that the decrease in growth rate of animals receiving At²¹¹ is presumably the result of endocrine changes. Simian myxedema has been observed in 4 monkeys treated with At²¹¹. A striking difference was seen in the rat between the thyroidal effects of I¹³¹ and At²¹¹ at high dosage levels. These differences appeared to be quantitative as well as qualitative. The chronic effects of irradiation of the thyroid gland with large doses of I¹³¹ in the rat were not only complete obliteration of the thyroid gland but almost complete destruction of the parathyroid gland and damage to the adjacent peritracheal structures. Chronic experiments in the monkey and the rat with At²¹¹ did not result in any injury to the parathyroid gland and adjoining peritracheal structures. Two years after apparently complete destruction of normal thyroid tissue by At²¹¹ in a monkey there were atypical cells present which demonstrated the capacity to accumulate and retain a tracer dose of I¹³¹. A high incidence of mammary tumors was observed in the rat following administration of At²¹¹. These tumors appeared neoplastic, and, on occasion, there were pulmonary metastases. The occurrence of these tumors is ascribed to endocrine changes rather than to the direct action of radiation from At²¹¹. (auth)

6924

HISTOLOGIC EFFECTS OF VARIOUS TYPES OF IONIZING RADIATION ON NORMAL AND HYPER-PLASTIC HUMAN THYROID GLANDS. Stuart Lindsay, Morris E. Dalley, and Malcolm D. Jones (Univ. of California School of Medicine, San Francisco). J. Clin. Endocrinol. and Metabolism **14**, 1179-1218(1954) Oct.

This study is concerned with the histologic changes in human thyroid glands following administration of various forms of internal and external irradiation. The lesions observed in thyroid glands irradiated with I¹³¹, x rays, radon, or neutrons were qualitatively similar. Acute epithelial injury, associated with necrotizing vasculitis and thrombosis, was the initial lesion resulting from high dosage of irradiation. Follicular atrophy accompanied by perifollicular fibrosis was characteristic of the late reaction produced by irradiation. Bizarre thyroid epithelial cells with hyperchromatic nuclei were observed in many irradiated glands, particularly the hyperplastic ones. These cellular changes were believed due to overstimulation and exhaustion, rather than to the direct effect of irradiation. Cellular changes due to irradiation were found only in glands subjected to high dosage of irradiation and examined relatively soon after the exposure. A significantly high incidence of Hashimoto thyroiditis was found in hyperplastic thyroid glands irradiated with I¹³¹ or x rays. This lesion was regarded as one effect of irradiation of the hyperplastic gland. The epithelial proliferative reaction in 2 of these glands led to the late development of multiple adenomas. These findings suggest the possibility of eventual development of malignant lesions in the irradiated hyperplastic human thyroid gland. (auth)

RADIATION HAZARDS AND PROTECTION

6925

PATHOGENESIS AND PATHOLOGY OF POST-IRRADIATION INFECTION. V. P. Bond and M. S. Silverman (U. S. Naval Radiological Defense Lab., San Francisco, Calif.) and E. P. Cronkite (Naval Medical Research Inst., Bethesda, Md.). Radiation Research **1**, 389-400(1954) Oct.

Mortality in animals suffering from the radioinduced intestinal syndrome results from severe changes in fluid and electrolyte balance leading to dehydration and vascular collapse; infection appears to be a relatively minor contributing factor. The life of a survivor of the intestinal syndrome or an individual exposed to lower doses of radiation and giving evidence of the hemopoietic syndrome is in reality exposed to the triple jeopardy of infection, hemorrhage, and anemia. Radiation intoxication is most logically correlated with the severe dehydration in the intestinal syndrome and bacterial intoxication in the hemopoietic syndrome. Infection is possible because of the severe leucopenia and impaired immune responses. Infection is precipitated by parenteral injection of or exposure to pathogens or by loss of integrity of the internal or external body surfaces permitting free access, growth, and diffuse invasion of commensal organisms. Hemorrhage is possible mainly because of the thrombocytopenia and may be spontaneous or induced by the minor traumata of living (defecation, coughing, vomiting, etc.) or by bacterial ulceration. Obviously, continued survival is impossible if marrow does not regenerate even if infection is controlled by antibiotics, and anemia and thrombocytopenia are controlled temporarily by transfusion. (auth)

6926

SUSCEPTIBILITY OF IRRADIATED ANIMALS TO INFECTION. I. L. Shechmeister (Washington Univ. School of Dentistry, St. Louis, Mo.). Radiation Research 1, 401-9 (1954) Oct.

Findings are summarized from studies on experimental animals which indicate that animals exposed either to lethal or to sublethal doses of x radiation demonstrate increased susceptibility to experimental infection and that bacteremia produced in these animals as a result of irradiation is an important factor in radiation death. Sublethal radiation was found to activate subclinical or latent infection in mice and possibly in rats. (C.H.)

6927

THE TIME-INTENSITY RELATIONS OF WHOLE-BODY ACUTE X-IRRADIATION AND PROTECTION BY β -MERCAPTOETHYLAMINE. Roberts Rugh and Helen Clugston (Columbia Univ., New York). Radiation Research 1, 437-47(1954) Oct.

6928

BIO-FLAVONOIDS IN RADIATION INJURY. I. THE EFFECT OF IONIZING RADIATION ON CAPILLARIES. Isidore Arons and John Freeman (Harlem City Hospital, New York City) and Boris Sokoloff and Walter H. Eddy (Florida Southern Coll., Lakeland). Brit. J. Radiol. 27, 583-5(1954) Oct.

Pre-treatment for ten days with 600 mg/day of bio-flavonoids, extracted from citrus fruit and known as CVP or citrus-vitamin P, afforded protection against radiation injury to the capillaries of the nail-bed in healthy human subjects subjected to 200 r of x radiation administered as a single dose. (C.H.)

6929

MODIFICATION OF RADIATION INJURY IN EXPERIMENTAL ANIMALS. Leon O. Jacobson (Argonne Cancer Research Hospital and Univ. of Chicago, Ill.). Am. J. Roentgenol. Radium Therapy Nuclear Med. 72, 543-55 (1954) Oct.

Measures which affect survival and the recovery of the blood-forming tissues of mammals following exposure to LD₁₀₀ doses of ionizing radiation are reviewed. Possible explanations of the mechanism of action of the protective measures are discussed. (C.H.)

RADIOGRAPHY

6930

THE USE OF RADIOACTIVE ISOTOPES FOR DIAGNOSTIC RADIOLOGY. G. E. Dennis and H. A. DeLuca (Univ. of Western Ontario, London, Canada). Am. J. Roentgenol. Radium Therapy Nuclear Med. 72, 661-5(1954) Oct.

Applications of radioisotopes in medical radiography are reviewed. The radiographic properties of Tm¹⁷⁰ and Ce¹⁴⁴ are evaluated and are illustrated photographically. It is concluded that the successful use of radioactive isotopes for medical radiography depends to a large extent on the availability of kilocurie sources of suitable isotopes. No isotope tested to date is ideal in all respects for this purpose. (C.H.)

RADIOTHERAPY

6931

RADIOGOLD SEEDS IN CLINICAL RADIATION THERAPY. Ulrich K. Henschke, Arthur G. James, and William G.

Myers (Ohio State Univ., Columbus). Radiology 63, 390-99 (1954) Sept.

Clinical experience in the first 100 patients treated at the Ohio State Medical Center with radiogold seeds has shown that these seeds can be used successfully as replacements for radon seeds. The simplicity of protection and the ease and rapidity of preparation of radiogold seeds of uniform strength are advantageous. No appreciable differences in therapeutic response were observed as compared with radon seeds. (auth)

6932

CANCER OF THE THYROID AND RADIOTHERAPY. B. W. Windeyer (Univ. of London and Middlesex Hospital, London, England). Brit. J. Radiol. 27, 537-52(1954) Oct.

Radiotherapeutic procedures used in the treatment of a series of patients with thyroid cancer are reviewed, and the merits of x-ray therapy and I¹³¹ therapy when complete surgical excision cannot be carried out are evaluated. (C.H.)

6933

A PNEUMATIC REMOTE CONTROL PRECISION INJECTOR FOR INTERSTITIAL AND INTRACAVITARY INJECTION OF RADIOACTIVE COLLOIDAL GOLD. S. Taplits (Jewish Hospital, Cincinnati, Ohio). Am. J. Roentgenol. Radium Therapy Nuclear Med. 72, 655-7(1954) Oct.

A description is given of a remote control injector which has been devised for the interstitial and intracavitary injection of radioactive colloidal gold solution. (auth)

6934

A TECHNIQUE FOR EVALUATING THE EFFECTIVENESS OF LOCALIZATION OF RADIOACTIVE COLLOIDAL GOLD-198 AFTER DIRECT INJECTION INTO TUMORS. John U. Hidalgo, Edgar Burns, and Robert T. Nieset (Tulane Univ. School of Medicine, New Orleans). Am. J. Roentgenol. Radium Therapy Nuclear Med. 72, 658-60 (1954) Oct.

A new procedure involving radioautographic and roentgenographic techniques has been described which provides a ready means of routine checking of the effectiveness of the direct injection of radioactive colloidal gold. The distribution data are based upon interpretation of the resulting films and, as so presented, afford rapid evaluation of the gross distribution picture and also comparative data on unit concentration in tumor, liver, and spleen. The technique as described has been developed around the direct injection of Au¹⁹⁸ into the prostate; however, there are no apparent limitations of the method. It would seem that this technique could be used in almost any procedure of a general type involving therapeutic dosage levels of radioactive materials in specific sites. (auth)

TOXICOLOGY STUDIES

6935

[Los Alamos Scientific Lab.]

BERYLLIUM—MEDICAL AND ENGINEERING CONTROL. [M. Chain Robbins. 1954]. 8p. Contract [W-7405-eng-36]. (AECU-2947)

Proper engineering techniques which are necessary to achieve environmental control of Be are discussed. Results from investigations into the physiochemical properties of Be compounds are reviewed. It is concluded that there is no

substitute for close cooperation between the industrial hygiene and medical groups in the protection of personnel handling Be and its compounds. (auth)

TRACER APPLICATIONS

6936

STUDIES WITH RADIOPHOSPHORUS IN DROSOPHILA. IV. EXPERIMENTS ON FLIES HOMOGENEOUSLY LABELED WITH P^{32} . R. C. King and Louise P. Wilson (Brookhaven National Lab., Upton, N. Y. and Wellesley Coll., Mass.). *J. Exp. Zool.* 126, 401-17(1954) Aug.

Drosophila homogeneously labeled with radiophosphorus have been produced by rearing flies for their entire life cycle on homogeneously labeled yeast growing on a solid, P^{32} -labeled synthetic medium. *Drosophila* adults contain 3 mg P/g wet weight and maintain their phosphorus content at this level, even when forced to feed on media abnormally rich in phosphorus. Death to adults occurs when the overall phosphorus content of the tissues rises above 0.4%. A study of the variation in phosphorus content during development showed the egg to contain the highest phosphorus concentration of any stage. The relation between total phosphorus and wet weight for first and second instar larvae was found to be bradyauxetic; for third instar larvae tachyauuxetic. The daily radiation dose to homogeneously labeled *Drosophila* developing on labeled medium was calculated. Under the experimental conditions ($1.24 P^{32}/1 \times 10^8 P^{31}$ at T_0) no detectable difference was noted between labeled and control *Drosophila* with respect to egg hatchability, eclosion, time required for development from egg to adult, and sex ratio of the resulting adults. Fecundity and fertility of F_1 -labeled females was lowered, and evidence is presented relating this to transmutation of internal P^{32} to S^{32} rather than to ionization. (auth)

CHEMISTRY

6937

Institute for the Study of Rate Processes, Univ. of Utah FLOCCULATION OF MINERAL SUSPENSIONS WITH COPRECIPIATED POLYELECTROLYTES. Milton E. Wadsworth and Ivan B. Cutler. June 1954. 19p. Contract AT(49-1)-633, Technical Report No. 4. (AECU-2939)

The effect of the coprecipitation of anionic and cationic polyelectrolytes has been applied to the flocculation of several mineral systems. Results obtained in a study of the flocculation of kaolinite and hematite suspensions by polycationic and polyanionic electrolytes are presented. Greatly increased settling rates were observed following the precipitation of positive and negative polyelectrolytes on the surface of finely divided minerals in aqueous suspension. The ratios of polycationic to polyanionic electrolytes required to produce maximum sedimentation have been shown to correspond closely with the equivalence points obtained by light scattering studies of systems containing the positive and negative polyelectrolytes by themselves. (auth)

6938

Institute for the Study of Rate Processes, Univ. of Utah RATE OF FLOCCULATION IN DILUTE CLAY SUSPENSIONS. Theron L. Mackay, Ivan B. Cutler, and Milton E.

Wadsworth. June 1954. 11p. Contract AT(49-1)-633, Technical Report No. 5. (AECU-2940)

The rate of flocculation has been empirically correlated using data from the initial or induction period in suspension sedimentation. The floc diameter calculated from fluid flow theory indicates a variation in floc size according to the equation $D^3 = k_1 t + k_2$, where D is floc diameter and t is time. This correlation indicates a zero order rate in terms of floc volume under the conditions of these studies. (auth)

6939

Institute for the Study of Rate Processes, Univ. of Utah VISCOSITY OF CLAY SUSPENSIONS IN THE PRESENCE OF POLYANIONIC FLOCCULANTS. Theron L. Mackay, Ivan B. Cutler, and Milton E. Wadsworth. June 1954. 13p. Contract AT(49-1)-633, Technical Report No. 6. (AECU-2941)

A study of the effect of organic flocculants on the viscosity of a clay suspension yields valuable information concerning the nature of flocculation. Increased flocculation appears to have a two-fold effect. Flocculation resulting in floc growth by swelling or addition of more mineral particles increases viscosity. The formation of tighter flocs of increased density decreases viscosity. This effect was evidenced for both organic and inorganic flocculants. The floc density is greater for organic flocculants as evidenced by a much greater decrease in viscosity compared to the effect of inorganic cations. This tight bonding may be attributed to mechanical bridging between particles. (auth)

6940

Laboratory for Nuclear Science, Mass. Inst. of Tech. CHEMISTRY OF THE FISSION ELEMENTS GROUP; NUCLEAR CHEMISTRY (INORGANIC) GROUP; AND NUCLEAR CHEMISTRY (ORGANIC) GROUP. p.1-52 of ANNUAL PROGRESS REPORT. [PROGRESS REPORT NO. 33 FOR PERIOD JUNE 1, 1953 TO MAY 31, 1954]. May 31, 1954. 52p. Contract AT(30-1)-905. (AECU-2943(p.1-52))

Chemistry of the Fission Elements Group, Preliminary experiments were made on the size and variability of the blank and the relative advantages of different methods of detecting the equivalence point in coulometric titrations. Pb can be determined coulometrically in micromolar solutions by deposition followed by coulometric dissolution. The deposition behavior of Ni onto a Hg pool from a thiocyanate solution by means of electrolysis at a constant potential was studied. Although the fluorescence spectra of Zn, Ga, and Al oxinates in chloroform solution are the same, the compounds respond differently to different exciting Hg lines. The preparation of a sample and the variability of the blank were studied in nephelometry. Measurements were made on the characteristics of Hg(CN), polarographic reduction in acidic, basic, and neutral solutions over a range of Hg(CN)₂ concentrations. In an effort to gain a clearer picture of the mechanism by which metal sulfides form and are precipitated in acid solutions, a detailed study is being made of the precipitation of NiS. An apparatus was built for the automatic performance of photometric titrations. A systematic study was made of the variables and interferences which affect the pyrophosphate method for the determination of Mn. The polarographic reduction of In in halide media yields data which are not consistent with the present picture of the relative stabilities of the In halide complexes. A spectrophotometer has been modified to contain a special "H" type cell and cover for the study of the decomposition rate of

ferric thioglycolate complexes in buffered alkaline media. The acidimetric titration curves of pyridine in concentrated salt solution were found to exhibit an increase in the apparent basic strength of pyridine over that observed in dilute salt solutions. Nuclear Chemistry (Inorganic) Group. An exploratory study of the use of relatively high-density organic and inorganic liquids and solutions for scintillators has been completed, and the results of the measurements on some organic scintillators are reported. The distribution of Ga^{+3} , In^{+3} , Tl^{+3} , and Au^{+3} between halogen acids and β, β' -dichlorodiethyl ether was studied. The ion exchange behavior of Cr^{+3} , V^{+4} , Mn^{+2} , Cd^{+2} , In^{+3} , Ga^{+3} , Cu^{+2} , Na^{+} , Co^{+2} , and Zn^{+2} was studied. The relative yields of various nuclides from the photospallation of As at 140- and 320-Mev synchrotron energy are tabulated. The yield curves from the 320-Mev bremsstrahlung irradiation of a natural Se target and a Se^{80} target indicate that the nuclide distributions are dependent on the target isotope. The $(\gamma, 5n)$ reaction of As was observed in the irradiation of Na cacodylate with 320-Mev bremsstrahlung. The relative yields of As^{70} , As^{72} , and As^{74} in the irradiation were determined. The relative yields of Br^{80m} and Br^{80} from the irradiation of Sr and Y were $\text{Br}^{80m}/\text{Br}^{80} = 4.6 \pm 0.9$ and 1.5 ± 0.5 , respectively. The fission of Bi with 15-Mev deuterons was studied. The half life of Cr^{55} was measured as 3.6 min, and the thermal neutron absorption cross section was found to be 0.4 b. An attempt to discover Pb^{205} by observation of its decay by K capture was unsuccessful. The fine structure in the fission yield of U in the mass region around 100 was studied. The decay scheme and energy of Cs^{132} was determined. Nuclear Chemistry (Organic) Group. A study of the isotope-position rearrangements in the diazotization of *exo*- and *endo*-norbornylamine-3- C^{14} was completed. Further work was carried out to provide evidence for the "benzyne" mechanism proposed for the amination of aryl halides. The kinetics of the exchange reactions of triphenylmethyl chloride with dioctadecyldimethylammonium chloride, fluoride and azide (labeled) in benzene solution at 50° were studied. The rates of exchange of deuterium between triethylammonium chloride-d and each of the alcohols, methanol, ethanol, and ethylene glycol, in the presence of HCl were measured at 0°C . Alternative mechanisms are suggested for the formation of a β -lactam from the reaction of an acid chloride with an imine in the presence of a tertiary amine. The tritium activity of a sample can be determined by measuring the ion current produced by the β emission of the tritium contained in H_2 obtained from the sample. (J.S.R.)

6941

Georgia Inst. of Tech. State Engineering Experiment Station
RESEARCH ON SURFACE PROPERTIES OF FINE PARTICLES. QUARTERLY REPORT NO. 2. J. M. Dallavalle, Clyde Orr, Jr., and H. G. Blocker. Oct. 30, 1951. 34p. Contract DA-36-039-sc-5411. (ATI-139487)

The low-temperature adsorption of N_2 and the adsorption of a fatty acid from liquid solution were found to be applicable to the surface area measurement and size measurement of finely divided materials. The gas adsorption method is limited to materials having a relatively large surface area and the fatty acid adsorption by unwieldy titration. (J.S.R.)

6942

Surface Chemistry Lab., Lehigh Univ.
HETEROGENEITY OF SURFACES. TECHNICAL REPORT

NO. 6 [FOR] JUNE 1, 1953 TO MAY 31, 1954. IMMERSION CALORIMETRY AND ADSORPTION STUDIES OF THE HETEROGENEOUS NATURE OF NICKEL AND CARBON SURFACES. J. J. Chessick, F. H. Healey, and Y. Yu. 64p. Contract N8onr-74300. (NP-5353)

Data are presented from studies of the physical adsorption of argon on oxide-coated and reduced Ni. A low temperature calorimeter to measure heats of immersional wetting in liquid N was constructed, and the heats of immersion of magnesia, silene, alumina, and Graphon (a graphitized carbon black) in liquid N were found to be practically the same. Theoretical values for the heat of immersion of magnesia in liquid N were calculated by two methods from adsorption data and were found to compare favorably with the experimental value. The effect of increasing the amount of surface oxide on Graphon on both the water vapor adsorption isotherms and the heat of immersion in water was studied, and data are presented graphically. (C.H.)

6943

Rochester Univ.

EXCHANGE REACTION OF GASEOUS BROMINE AND HYDROGEN BROMIDE. Wade L. Callender and Edwin O. Wiig. Oct. 11, 1954. 21p. Contract AT(30-1)-655. (NYO-6635)

The rate of the exchange reaction between gaseous bromine and hydrogen bromide at various partial pressures has been measured at room temperature and -16° and at times of contact of 0.1 to 6.25 seconds in a flow system with argon at atmospheric pressure as the carrier gas. The rate of reaction first increases and then reaches a limiting value as the pressure of bromine and of hydrogen bromide is increased. The reaction is extremely rapid, with a rate of approximately 2×10^{-4} equivalent/liter/sec, corresponding to a half life for exchange at the pressures studied of 0.08 and 0.03 sec in unpacked and packed vessels, respectively. The exchange is postulated to occur by two methods, one a heterogeneous reaction and the other a homogeneous chain reaction initiated at the walls. (auth)

6944

ELECTROCHEMICAL INVESTIGATION OF THE SYSTEM Sn-Na. Yu. K. Delimarskii and A. A. Kolotil. Zhur. Fiz. Khim. 28, 1169-73(1954) July. (In Russian).

The results of electrochemical investigations of the system Sn-Na are given. The activity and activity coefficients of both components were determined as a function of the molar concentrations. The partial molar heat of mixing was calculated as a function of the concentration. Investigation of the dependence of the activity coefficient and of the magnitude of $RT \ln f$ on the molar concentration showed a divergence of the system Sn-Na from the ideal mixture. The dependence of the emf on the atomic concentration agrees with the structural diagram. (J.S.R.)

ANALYTICAL PROCEDURES

6945

Ames Lab.

ANALYTICAL APPLICATIONS OF THE REACTION OF THORIUM WITH BENZENEPHOSPHONIC ACID. Charles V. Banks and Rodney J. Davis. Sept. 22, 1954. 22p. Contract W-7405-eng-82. (ISC-524)

Benzenephosphonic acid quantitatively precipitates thorium as $\text{Th}(\text{C}_6\text{H}_5\text{PO}_3)_2 \cdot 3\text{H}_2\text{O}$ at pH values as low as 0.5.

The compound may be dried at 140 to 180°C and weighed as a gravimetric means of determining thorium. On ignition $\text{Th}(\text{C}_6\text{H}_5\text{PO}_3)_2 \cdot 3\text{H}_2\text{O}$ undergoes decomposition at 240 to 300°C to form $\text{Th}(\text{C}_6\text{H}_5\text{PO}_3)_2 \cdot 2\text{H}_2\text{O}$, at 450 to 650°C to form $\text{Th}(\text{HPO}_3)_2 \cdot 2\text{H}_2\text{O}$, and finally at 800 to 1000°C to form $\text{Th}(\text{HPO}_3)_2$. The latter compound is stable to 1200°C. Potentiometrically ($\text{pK}'_1 = 0.91$, $\text{pK}'_2 = 6.41$) and spectrophotometrically ($\text{pK}'_1 = 0.96$, $\text{pK}'_2 = 6.51$) determined pK' values are reported. Absorption spectra of $\text{C}_6\text{H}_5\text{PO}_3\text{H}_2$, $\text{C}_6\text{H}_5\text{PO}_3\text{H}^-$, and $\text{C}_6\text{H}_5\text{PO}_3^{2-}$ are reported. The solubility of $\text{Th}(\text{C}_6\text{H}_5\text{PO}_3)_2 \cdot 3\text{H}_2\text{O}$ was studied as a function of pH, and the average value of the solubility product ($K_{\text{sp}} = 4\text{s}^3$) was found to be 3.24×10^{-31} . (auth)

6946

Tennessee Univ.

SCOPE 1. FLAME PHOTOMETRIC STUDY OF BORON.
SCOPE 2. FLAME PHOTOMETRIC DETERMINATION OF ELEMENTS ASSOCIATED WITH BORON IN BORON CONTAINING COMPOUNDS. PART 1. COPPER. FINAL PROJECT REPORT. June 1954. 51p. [For Mathieson Chemical Corp., Contract No(s)-52-1023-C], Subcontract M-3181-15. (MCC-1023-TR-59)

A flame photometric method for the determination of B was developed using the Beckman flame spectrophotometer equipped with the photomultiplier attachment. The effects of elements commonly associated with B upon the flame emission of B are reported. The method is comparable in accuracy and precision to existing chemical and spectrographic procedures. A procedure is also described for the flame photometric determination of Cu in B, in which the Cu line is calibrated with the Ag lines at 328.0 and 338.3 μ . The method possesses a precision and accuracy of approximately 3%, and the time for analysis is much shorter than the conventional chemical procedures. (J.S.R.)

6947

Chalk River Project (Canada)

IMPROVED PROCEDURE FOR THE DETERMINATION OF RADIOACTIVE YTTRIUM IN AQUEOUS SOLUTIONS OF THE LONG LIVED FISSION PRODUCT ACTIVITIES. E. Mizzan. June 15, 1954. 21p. (PDB-126)

A modification of the laboratory procedure for the determination of yttrium activity in the presence of the long-lived fission product activities is presented. The modified procedure eliminates the fluoride, one iodate, and one hydroxide precipitation. Good decontamination from the other long-lived fission products, high radiochemical purity, and good radiochemical yields are obtained. The results are very consistent and agree favorably with those obtained by the present laboratory procedure. The method gives a precision of about $\pm 1.5\%$. (auth)

6948

ANALYTICAL PROCEDURES USING A COMBINED COMBUSTION-DIFFUSION VESSEL. SIMPLE WET-COMBUSTION METHOD SUITABLE FOR ROUTINE CARBON-14 ANALYSES. Nome Baker, Harold Feinberg, and Robert Hill (Veterans Administration Hospital, Cleveland, Ohio, and Univ. of Calif., Berkeley). *Anal. Chem.* 26, 1504-6(1954) Sept.

By using a screw-cap bottle with a smaller compartment within, it is possible to recover CO_2 from the semi-quantitative oxidation of a series of organic compounds with Van Slyke-Folch combustion fluid. The method, although not completely quantitative, is satisfactory for the

routine analysis of isotopically labeled, dry, nonvolatile compounds. (J.S.R.)

6949

DETERMINATION OF THE SHORT-LIVED DECAY PRODUCTS OF RADON IN NATURAL WATERS. P. K. Kuroda (Univ. of Arkansas, Fayetteville) and Yuji Yokoyama (Univ. of Tokyo, Japan). *Anal. Chem.* 26, 1509-11(1954) Sept.

The short-lived products of Rn in natural water in Japan and the United States were determined by evaporation of the water or coprecipitation of the decay products with PbS. The time consumed in each step of the procedure was accurately determined. The α radioactivity was determined, and the results are tabulated. (J.S.R.)

6950

RADIOCHEMICAL DETERMINATION OF NEODYMIUM, PRASEODYMIUM, AND CERIUM IN FISSION PRODUCTS. Henry G. Petrow (Tracerlab, Inc., Boston, Mass.). *Anal. Chem.* 56, 1514-15(1954) Sept.

A radiochemical procedure is outlined for determining Pr^{143} , Ce^{144} , and Nd^{147} formed in the fission of natural U. (L.T.W.)

6951

ESTIMATION OF THORIUM BY ORGANIC REAGENTS. PART I. PHENYLGLYCINE-*o*-CARBOXYLIC ACID. Sachindra Kumar Datta and Gurupada Benerjee (Darjeeling Government Coll., India). *J. Indian Chem. Soc.* 31, 149-52(1954) Feb.

A convenient method for the estimation of thorium and its separation from cerite earths present in monazite, with the use of phenylglycine-*o*-carboxylic acid, is described. (auth)

6952

ESTIMATION OF THORIUM BY ORGANIC REAGENTS. PART II. 2,4-DICHLOROPHENOXY- AND GUAIACOXY-ACETIC ACIDS. Sachindra Kumar Datta and Gurupada Banerjee (Darjeeling Government Coll., India). *J. Indian Chem. Soc.* 31, 397-401(1954) May.

Thorium has been quantitatively precipitated without using any electrolyte by 2,4-D at pH 2.8 and by guaiacoxycetic acid at pH 4.4 in presence of Ca, Ba, Mg, Zn, etc., and cerite earths. (auth)

6953

A PHOSPHATE TITRIMETRIC PROCEDURE FOR THE ESTIMATION OF MAGNESIUM, ZINC, MANGANESE AND CADMIUM. P. R. Subbaraman (National Chemical Lab. of India, Poona). *J. Sci. Ind. Research (India)* 13, 553-6 (1954) Aug.

The method of titrating phosphates by bismuthyl perchlorate in presence of diallyldithiocarbamido-hydrazine in chloroform as indicator has been extended to the estimation of magnesium, zinc, manganese and cadmium. These metals are precipitated as their double ammonium phosphates and titrated with bismuthyl perchlorate after dissolution in dilute perchloric acid. From the phosphate contents of the precipitates the stoichiometric equivalents of the metals are computed. Besides being equally reliable, the titrimetric method is simpler and more elegant than its gravimetric counterpart. (auth)

ATOMIC WEIGHTS AND PERIODIC SYSTEMS

6954

PRINCIPLE CONSIDERATIONS IN THE PERIODIC SYSTEM OF ELEMENTS. IX. RELATIONSHIP BETWEEN

NUCLEUS AND SHELL. Richard Lepsius and K. S. Asunmaa. *Naturwissenschaften* 41, 366-8(1954) Aug. (In German).

6955

ATOMIC WEIGHTS OF THE MONOISOTOPIC ELEMENTS. Henry E. Duckworth (McMaster Univ., Hamilton, Ontario, Canada). *Nature* 174, 595-6(1954) Sept. 25.

The mass of Cs^{137} , Th^{150} , Tm^{169} , Ta^{181} , and Au^{197} can be approximated by plotting the mass defect vs. mass number for even-A nuclides. The odd-A nuclides with known mass are displaced by a regular amount. The masses of the unknown odd-A nuclides can then be obtained by interpolation with an error no larger than 3 mu. (J.S.R.)

DEUTERIUM AND DEUTERIUM COMPOUNDS

6956

MASS SPECTRA OF THE DEUTEROETHYLENES. Vernon H. Dibeler, Fred L. Mohler (National Bureau of Standards, Washington, D. C.), and M. de Hemptinne (Univ. of Louvain, Belgium). *J. Research Natl. Bur. Standards* 53, 107-11(1954) Aug.

Samples of all of the deuterioethylenes have become available in satisfactory purity, and mass spectra have been measured and corrected for isotopic impurities. The mass spectra of cis and trans dideuterioethylene are nearly identical, and the spectrum of the asymmetrical di-deuterioethylene is similar to the symmetrical molecules in the mass range 24 to 30. The probability of removing an H atom from the deuterioethylenes relative to the probability in C_2H_4 is equal to the a priori probability times 1.10, $(1.10)^2$, and $(1.10)^3$ in molecules containing 1, 2, and 3 D atoms, and the relative probability of removing a D atom is 0.90 in C_2D_4 and is nearly equal to the a priori probability times $(0.90)^2$, $(0.90)^3$, and $(0.90)^4$ in molecules C_2HD_3 , $\text{C}_2\text{H}_2\text{D}_2$, and $\text{C}_2\text{H}_3\text{D}$, respectively. As the factors 1.10 and 0.90 are nearly reciprocals, these ratios can be expressed as positive and negative powers of 1.10. The probabilities of removing 2, 3, or 4 atoms are powers or products of the probability of removing single atoms, and thus are also positive and negative powers of 1.10. Similar relations are found in the previously published data on deuterioacetylenes. (auth)

LABORATORIES AND EQUIPMENT

6957

Los Alamos Scientific Lab.

SAMPLE COLLECTOR AND COUNTER. James B. Deal, Jr. and John F. Buchen. July 27, 1954. 20p. Contract W-7405-eng-36. (LA-1677)

An apparatus is described which automatically separates a flow of drops into a series of equal samples. The samples are collected on foils or in small beakers placed around the outside edge of a rotating turntable. The drops are counted by means of a phototube amplifier which advances a stepping relay whenever a drop interrupts a small beam of light. The stepping relay, in turn, controls the rotation of the turntable. (auth)

6958

THE LABORATORY MICROCYCLONE. Paul Raffinot. Translated by J. A. Holmes from *Rev. ind. Minerale* 34, 1016-24(1953). 12p. (AERE-Trans-11/3/5/441)

RADIATION CHEMISTRY

6959

[Frick Chemical Lab.], Princeton Univ.

RESEARCH IN HIGH POLYMER CHEMISTRY—RATES OF INITIATION IN VINYL POLYMERIZATION. TECHNICAL REPORT NO. 3. THE INTERACTION OF BETA PARTICLES WITH ORGANIC LIQUIDS IN THE PRESENCE OF VINYL MONOMERS. 2. THEORY FOR A POINT SOURCE. W. H. Seitzer and A. V. Tobolsky. Sept. 25, 1954. 12p. Contract DA-36-034-ORD-1496. (NP-5348)

An expression is derived which relates the rate of chain initiation to the measured rate of free radical polymerization produced by the beta-ray irradiation of a solution of a vinyl monomer. A constant which appears in this relationship is the average absorption, coefficient for the beta particles. This was determined experimentally for the Sr^{90} - Y^{90} source. (auth)

6960

[Frick Chemical Lab.], Princeton Univ.

RESEARCH IN HIGH POLYMER CHEMISTRY—RATES OF INITIATION IN VINYL POLYMERIZATION. TECHNICAL REPORT NO. 4. THE INTERACTION OF BETA PARTICLES WITH ORGANIC LIQUIDS IN THE PRESENCE OF VINYL MONOMERS. 3. CALCULATION OF RATES OF INITIATION. W. H. Seitzer and A. V. Tobolsky. Oct. 1, 1954. 11p. Contract DA-36-034-ORD-1496. (NP-5349)

The rates of initiation of free-radical polymerization caused by the absorption of beta radiation were determined for some common organic solvents. The efficiencies of energy utilization for pure substances range between 0.2 radical chain starters per 100 ev for styrene to 10.2 radical chain starters per 100 ev for carbon tetrachloride. (auth)

6961

Chalk River Project (Canada)

SELF-ABSORPTION AND SELF-SCATTERING CORRECTION FACTORS FOR THE LONG LIVED FISSION PRODUCT ACTIVITIES. E. Mizzan. May 25, 1954. 16p. (PDB-127)

A study was made of the effect of source weight variation on the counting rate of the separated fission product activities and their inactive carriers. A set of graphs are presented from which correction factors for self-absorption and self-scattering can be directly obtained. The fission product activities studied are Sr^{90} , Y^{90} , Ce^{144} , and Cs^{137} . Corrections are not required in the Ru^{106} procedure. The application of the corrections for self-absorption, self-scattering and radiochemical yield in the determination of the fission product activities is briefly discussed. (auth)

6962

Radiation Lab., Univ. of Calif., Berkeley

SOME EFFECTS OF DISSOLVED OXYGEN ON THE HEAVY PARTICLE IRRADIATION OF AQUEOUS ACETIC ACID.(thesis). Herman R. Haymond. Sept. 1954. 36p. Contract W-7405-eng-48. (UCRL-2697)

When oxygen is present during the irradiation of aqueous acetic acid with high-energy helium ions, the yields of carbon dioxide and hydrogen peroxide increase, and the yields of succinic acid decreases as compared to the evacuated system. Glycolic acid, formaldehyde, and glyoxylic acid appear as products. A mechanism is proposed which involves the reactions of two $\text{O}_2\text{CH}_2\text{COOH}$ radicals to form $2\text{OCH}_2\text{COOH} + \text{O}_2$ and subsequent reactions of the OCH_2COOH radicals to form the products ob-

served. It is unlikely that HO_2 plays an important part in formation of the organic products determined. The low yields obtained indicate that a chain reaction does not occur. (auth)

RADIATION EFFECTS

6963

PILE IRRADIATION OF POLYETHYLENE TEREPHTHALATE ('TERYLENE'). Audrey Todd (Imperial Chemical Industries, Ltd., Welwyn Garden City, Hertfordshire, England). *Nature* 174, 613(1954) Sept. 25.

The solution viscosities of two ethylene terephthalate polymers were measured in o-chlorophenol at 25°C before and after varying amounts of radiation. Huggin's viscosity slope constant rose with increase of radiation dose and the viscosity fell. The samples show a small but significant decrease in Vicat softening point. These results indicate that the effect of pile irradiation is degradative, possibly accompanied by branching. (J.S.R.)

6964

ENERGY TRANSFER IN IRRADIATED SOLUTIONS OF MIXED PHOSPHORS. Frank E. E. Germann, Frank T. Brown, Richard Wissell, and Thomas D. Waugh (Univ. of Colorado, Boulder). *Science* 120, 540-2(1954) Oct. 1.

Mechanisms of energy transfer in irradiated solutions containing 3 to 4 g of a primary phosphor such as p-terphenyl and about 0.05 g of a secondary phosphor such as alphanaphthylphenyloxazole were investigated by normal ultraviolet spectrographic procedures. Generalizations based on analysis of the data are presented. (C.H.)

6965

ON THE RELATIVE RADIOCHEMICAL EFFECTIVENESS OF MIXED RADIATION FROM ATOMIC PILES AND γ RADIATION. Adolphe Chapiro. *Compt. rend.* 239, 703-5(1954) Sept. 20. (In French).

Radiation effects on the structure and oxidation states of several organic and inorganic chemicals by exposure to neutron and γ radiation from ZOE are compared with the amount of γ radiation from a Co^{60} source needed to produce comparable effects. Chemicals tested were ferrous sulfate, styrene, polyethylene, ferric salt of 1, 10-phenanthroline, and methyl methacrylate polymers. The radiochemical equivalent of pile radiation at 10^{17} n/cm² is equivalent to a dose of 7.5 to 11 mr at a power of 10 kw, and of 4.5 to 8 mr for a power of 100 kw. (K.S.)

6966

EFFECT OF X-IRRADIATION ON THE ABSORPTION SPECTRUM OF PURINES AND PYRIMIDINES. E. S. Guzman Barron, Phyllis Johnson, and Aspasia Cobure (Univ. of Chicago, Ill.). *Radiation Research* 1, 410-25 (1954) Oct.

X irradiation of aqueous dilute solutions of deoxyribonucleate, ribonucleate, and a number of purines and pyrimidines decreased the ultraviolet absorption at 2600 Å, the decrease being proportional to the x-ray dose in all cases. The effect was more pronounced in the simple purine and pyrimidine compounds; as the molecule became more complex on addition of other groups, such as pentose and phosphoric acid residues, it became more resistant to the action of ionizing radiations. The decrease in the absorption spectrum was greater on irradiation in the presence of oxygen than on irradiation in the presence of nitrogen. Reduced diphosphopyridine nucleotide was readily oxidized by x irradiation, and the oxidation was

more effective on irradiation in O_2 than on irradiation in N_2 . Pyridine nucleotide reduced by x irradiation in the absence of nitrogen and in the presence of lactate or alcohol was reduced to a compound which was partially active enzymatically. (auth)

RARE EARTHS AND RARE-EARTH COMPOUNDS

6967

SOME OBSERVATIONS ON THE ELECTROLYSES OF SOLUTIONS OF RARE-EARTH METAL SALTS IN BASIC SOLVENTS. Therald Moeller and Paul A. Zimmerman (Univ. of Illinois, Urbana). *Science* 120, 539-40(1954) Oct. 1.

Anhydrous Y acetate, Nd bromide, La nitrate, and impure Nd iodide were electrolyzed in anhydrous ethylenediamine and monoethanolamine. Electrolyses with ethylenediamine solutions gave cathode deposits with all salts tested, but no deposits were obtained with monoethanolamine solutions. Observations on the electrolysis and characteristics of the deposits are reported. (C.H.)

6968

REDUCTION OF THE NITRATE ION IN THE PRESENCE OF LANTHANUM IN ACID MEDIUM. A. N. Frumkin and S. I. Zhdanov. *Doklady Akad. Nauk S.S.S.R.* 97, 867-70 (1954) Aug. 11. (In Russian).

The mechanism of the reduction of NO_3^- in the presence of La in acid medium was studied. Polarization curves are given for varying acid concentrations. (J.S.R.)

SEPARATION PROCEDURES

6969

Battelle Memorial Inst.

THE ALKALINE LEACHING OF URANIUM ORES PROPOSED AS FEED TO THE PILOT PLANT AT GRAND JUNCTION, COLORADO. PROGRESS REPORT [NO. 1 FOR THE PERIOD MARCH 24, 1954 TO AUGUST 6, 1954]. C. M. Wheeler, B. Langston, and F. M. Stephens, Jr. Aug. 20, 1954. 46p. (AECU-2946)

A research program was made to evaluate the amenability of uranium-bearing ores to an alkaline leach, and to obtain data to design the Grand Junction, Colo., pilot plant. The data obtained from an investigation of eight ores showed that, to obtain the maximum extraction of uranium, the fastest settling rate, and the optimum filtering conditions, each of the ores required specific treatment. At the same time, the data showed that some of the ores were quite similar in their response to the alkaline-leach process. The ores are discussed on this basis. (auth)

6970

Radiation Lab., Univ. of Calif., Berkeley

SEPARATION OF LIQUIDS BY THERMAL DIFFUSION (thesis). John Edward Powers. Aug. 1954. 162p. Contract W-7405-eng-48. (UCRL-2618)

The separation of liquid mixtures in continuous flow thermogravitational columns was investigated experimentally and theoretically. Two continuous-flow thermogravitational columns were built and operated to determine the effect of changing several operating variables. The data obtained are in qualitative agreement with the theory of Furry, Jones, and Onsager as modified in this thesis. Three additional corrections are necessary to bring the theory into quantitative agreement with the data. In the laminar-flow range individual corrections are re-

quired for both low and high convective flow rates without turbulence. A third correction is necessary when turbulence is encountered. A correlation of the correction necessary at high convective flow rates without turbulence (the only region investigated) is proposed which includes data on both liquid and gas systems. Design procedures to aid in the development of thermal diffusion plants are developed and summarized. A plant to treat 1,000 barrels per day of a liquid aromatic-aliphatic mixture is designed, and costs are estimated. Data obtained in a small glass-diaphragm thermal diffusion cell were not consistent with data from the continuous-flow thermogravitational column. An extensive review of the literature on all phases of thermal diffusion is included. (auth)

6971

LIQUID-LIQUID EXTRACTION APPLIED TO SYSTEMS OF FOUR COMPONENTS. Alicia Crespi. Translated from *Rev. Sienc. apl. Madrid* 6, 331-46(1952). 23p. (AERE-Trans-11/3/5/436)

Methods of contact in liquid-liquid extraction operations involving dilute systems of four components are reviewed. Processes are evaluated which have for their object the separation of two substances or groups of substances, using two immiscible solvents which form two solvent phases, each one selective in a different degree for the two components or two groups of components of the mixture. Extraction calculations applicable to the processes are included. (C.H.)

6972

ION EXCHANGE. Nevin K. Hlester and Russell C. Phillips (Stanford Research Inst., Calif.). *Chem. Eng.* 61, 161-80 (1954) Oct.

A complete review is presented of the mechanisms, techniques, applications, and economic aspects of ion exchange. Much of the new information presented came from 32 replies to a questionnaire which was sent to 50 companies known to be active in the field of industrial ion exchange. The types and availability of exchange materials are first discussed, after which the methods (batch, fixed bed, continuous, and electromembrane) are outlined. It is felt that with a better understanding of design fundamentals and with new equipment and materials, this unit operation will continue to find an increasingly important place in the process industries. (L.M.T.)

SORPTION PHENOMENA

6973

THE KINETICS OF NON-STATIONARY HETEROGENEOUS PROCESSES. 1. THE KINETICS OF THE ABSORPTION OF OXYGEN BY WATER. M. Tovbin and A. Konenko. Translated from *Zhur. Fiz. Khim.* 22, 1331-43(1948). 14p. (AERE-Trans-11/3/5/448)

A method is presented for the investigation of the kinetics of the nonstationary process of absorption of a gas by a liquid. The method is based on determination of the rate of gas absorption by falling drops of liquid and enables the duration of contact between the reacting phases to be reduced to 0.02 to 0.03 sec. Results are presented from an investigation of the kinetics of the nonstationary process of oxygen absorption by water from air. An equation is deduced for the rate of the nonstationary process of the solution of a gas in a liquid, which agrees with the experimental data. Data are also included on the effect of temperature upon the rate of a nonstationary process of ab-

sorption and the effect of admixtures of surface-active substances on the rate of the nonstationary process of oxygen absorption. (C.H.)

6974

INVESTIGATION OF THE ABSORBENT PROPERTIES OF NON-POWDERED GAS ABSORBERS. E. Lyubovskaya and A. Ravdel. *Zhur. Tekh. Fiz.* 24, 1393-1400(1954) Aug. (In Russian).

The temperature dependence of the absorption capacity of Zr and Ti-Th alloys for H_2 and O_2 was determined. A comparatively narrow range of absorption was found for H_2 on Zr at 500°C, but increasing amounts of O_2 were absorbed starting at 400°C. Some H_2 absorbs at room temperature. The range of absorption of H_2 on Ti-Th varies from 400 to 600°C, and practically none is absorbed at room temperature. Intensive absorption of O_2 begins at 500°C and increases with further increase of temperature. The absorption capacity of Ti-Th for H_2 is approximately twice as large as that of Zr, but Zr has a correspondingly higher capacity for O_2 than Ti-Th. (J.S.R.)

TRANSURANIC ELEMENTS AND COMPOUNDS

6975

THE OPTICAL SPECTRUM OF PLUTONIUM AND ITS HYPERFINE STRUCTURE. Martha Van den Berg and P. F. A. Klinkenberg (Univ. of Amsterdam, Netherlands). *Physica* 20, 461-80(1954) Aug. (In English)

Plutonium is excited in a hollow cathode discharge, and the emitted light in the wavelength region 2900 to 6490 Å is observed by means of prism spectrographs. The wavelengths of nearly 2000 Pu lines are measured against argon reference lines with an accuracy corresponding to an approximately constant mean wave number error of ± 0.2 K in the region above 3705 Å and of ± 1.0 K in the shorter wavelength region. By comparing the intensities with those observed in spark discharges by other authors, a preliminary separation of the stronger Pu I and Pu II lines is possible. About 85% of the lines observed in the hollow cathode belong to Pu I. This is confirmed by a recent paper on the furnace spectrum. A list is given of the 714 strongest observed lines, with the assignment to Pu I or Pu II. The 75 strongest Pu lines between 4020 and 6200 Å are examined by means of etalons, and a hyperfine structure doubling is found in 30 of them, with separations of 34 to 181 mK. It is proved that this doubling is due to a Pu^{239} nuclear spin value $I = \frac{1}{2}$. Intensity measurements in some selected doublets show that high J values are involved in the observed transitions. Possible consequences with regard to the electronic structure of the free atom are discussed. The nuclear spin value of Pu^{239} is considered in the light of the nuclear shell model. (auth)

URANIUM AND URANIUM COMPOUNDS

6976

Institute for the Study of Rate Processes, Univ. of Utah
THE FLOCCULATION OF LOW GRADE OXIDE URANIUM ORES. [PART] 1. Milton E. Wadsworth, Ivan B. Cutler, and Melvin A. Cook. Feb. 16, 1953. 25p. Contract AT(49-1)-633, Technical Report No. 1. (AECU-2936)

Preliminary settling tests were carried out on low-grade U ores in both acidic and basic circuits. Viscosity measurements and filtration rate studies were made on the settled ore pulp. Improved settling conditions were obtained on the basic side at low flocculant concentrations and

on the acid side at high flocculant concentrations. In general, the filtration rate was improved if the settling rate was improved. Viscosity measurements indicated qualitatively the degree of flocculation, although the correlation is not distinct. Preliminary tests have indicated improved settling and filtration rates upon the addition of several new types of polyanionic electrolytes. (J.S.R.)

6077

Institute for the Study of Rate Processes, Univ. of Utah
THE FLOCCULATION OF LOW GRADE OXIDE URANIUM ORES. [PART] 2. Milton E. Wadsworth, Ivan B. Cutler, and Melvin A. Cook. Mar. 13, 1953. 10p. Contract AT(49-1)-633, Technical Report No. 2. (AECU-2937)

The effectiveness of different flocculants for low-grade U ores was determined by means of settling and filtration tests. (J.S.R.)

ENGINEERING

6078

EVALUATION OF SUPERHEATER MATERIALS FOR HIGH-TEMPERATURE STEAM. Bela Ronay and W. E. Clautice (Naval Engineering Experiment Station, Annapolis, Md.). Welding J. (N. Y.) 33, 199s-205s(1954) Apr.

The experimental installation for evaluation of superheater materials in contact with steam at temperatures between 1100 and 1500° F was designed and fabricated. (L.T.W.)

6079

HIGH-PRESSURE VESSELS SUBJECTED TO STATIC AND DYNAMIC LOADS. E. D. Narduzzi (Univ. of Montreal and Dominion Bridge Co., Ltd., Lachine, Quebec, Canada) and Georges Welter (Univ. of Montreal, Quebec, Canada). Welding J. (N. Y.) 33, 230s-8s(1954) May.

Elastic stress-strain relations for external and in internal walls for cylindrical shells subjected to internal pressure were derived. Actual stresses were compared to theoretical stresses. The application of various theories of fracture is discussed. Suggestions are made for design formulas. (L.T.W.)

6080

STRESSES FOR PRESSURE VESSELS AND BOILERS UP TO 650° F. W. P. Kerkhof (Royal Dutch/Shell Group, The Hague, Netherlands). Welding J. (N. Y.) 33, 239s-51s(1954) May.

The problem of the stresses occurring in boilers and pressure vessels has been studied with the aid of both the theory of plasticity and the theory of elasticity, taking into account the residual stresses in the weld and in the non-welded plate and the stress-relieving effect of the hydrostatic test. The calculated maximum total stress occurring is nearly always equal to the yield point of the material and independent of the allowable membrane stress and weld efficiency used for the calculation. As such a high stress always occurs, it cannot have any influence on the rupture of the vessel. Rupture can only be due to cracks or other faults in manufacture and/or design. Such faults result in stress concentrations far above the yield point. In this case the state of stress is triaxial. It is known that the material only fails as a result of those high stress concentrations. As the total stress occurring is not dependent on the membrane stress used for calculation, the

latter should be as high as possible. An allowable membrane stress of 66% of the yield point is recommended. The permissible superimposed bending stress can also be 66% of the yield point. In case pure bending stresses exist, the allowable stress can be equal to the yield point. The test pressure should load the vessel to a stress 1.3 times the allowable membrane stress at atmospheric temperature. The proposed allowable stress and test pressure limit the deformation of the material in such a way that no rupture can occur due to excessive strain. The weld efficiency should always be 100%. The use of a factor of safety is not based on sound reasoning. Stress relieving is not necessary with a view to strength and should only be carried out for improvement of the mechanical properties of the material and perhaps in the case of very thick shells. Radiographing should be carried out when a possible rupture would cause an explosion and in all other cases where a rupture is dangerous. In some cases, if the weldability of the material is low, radiographic examination is also required. (auth)

HEAT TRANSFER AND FLUID FLOW

6081

Mine Safety Appliances Co.

NATURAL CIRCULATION WITH NaK-56 IN FOUR VERTICAL UNBAFFLED HEAT EXCHANGERS. M. J. McGoff and J. W. Mausteller. Sept. 30, 1954. 54p. Contract NObs 65426, Technical Report No. 32. (NP-5350)

Natural convection cooling of tubes by NaK 56 was investigated in four vertical un baffled heat exchangers. Three multitube exchangers contained either 0.125 or 0.250 in. OD tubes, and one exchanger contained a single 0.500 in. OD tube. The same exchangers were also tested under forced convection conditions. Natural circulation shell-side film coefficients ranged from 360 to 2,860 Btu/hr/ft²/°F, with corresponding Reynolds numbers of 475 to 19,500. A general correlation of natural circulation and forced circulation points was made for the three multitube exchangers. Natural circulation data for the single tube exchanger do not lie on the curve. (auth)

6082

STABILITY OF GAS FLOW IN A TUBE AS RELATED TO VERTICAL ANNULAR GAS-LIQUID FLOW. A. D. K. Laird (Univ. of California, Berkeley). Trans. Am. Soc. Mech. Engrs. 76, 1005-10(1954) Oct.

A model study of the pressure drop in the gas column of an upward annular gas-liquid flow system is described. The models were two rubber tubes with walls oscillating as axisymmetric standing waves. Pressure drops were shown to increase rapidly with increase of wave length, wave amplitude, and wave frequency. The mathematical analysis of the system was extended. (auth)

MATERIALS TESTING

6083

PROBOLOG—AN APPLICATION OF EDDY CURRENT TECHNIQUES TO NON-DESTRUCTIVE TESTING. William J. Warren (Shell Development Co., Emeryville, Calif.). Corrosion 10, 318-23(1954) Oct.

A physical picture of eddy currents and their effects on the parent magnetic field is recalled. The basic configuration of the Probolog probe and its electrical relation to the eddy current paths in the tubing under test are considered. Probe action in detecting corrosion is expressed in terms

of voltages corresponding to simulated effects in the tubing. These voltages appear at the detector diagonals of the Wheatstone bridge of which the probe is a part. They are amplified, detected, and recorded on a strip chart. Controls provided in the bridge circuit permit some adjustment for accommodating the voltages for various nonmagnetic materials. Some special applications of the Probolog principle to other nondestructive testing operations are described briefly. (auth)

6984

DIFFERENTIAL THERMAL ANALYSIS TECHNIQUE AND ITS APPLICATIONS. V. S. Ramachandran and S. K. Bhattacharyya (Indian Inst. of Tech., Kharagpur). *J. Sci. Ind. Research (India)* 13, 365-72(1954) Aug.

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

6985

Armour Research Foundation

APPLICATION OF FUNDAMENTAL CONCEPTS OF BONDING METALS AND CERAMICS. Harold A. Barr, Louis Marchi, Harold H. Rice, and James A. Stavrolakis. Oct. 1953. 48p. Contract AF33(616)-97. (WADC-TR-53-356; AD-27519)

The theoretical basis for selecting borides and transition elements to study cermet structures is reviewed. The conditions, considered important for forming oxidation-resistant cermets, are: (a) bonding must occur between metal and nonmetal, (b) melting points of the metal must be near the operating temperature, (c) oxides of the metal should be refractory, and (d) the lattice of the oxide must be sufficiently tight to decrease the diffusion of oxygen. It is pointed out that the strength of bond between metal and nonmetal depends on more than just the qualitative aspects mentioned above. Another factor is the number of bonds per unit volume. For example, calcium has +2 free electrons per ion and manganese has +5.5. The empirical work indicates that manganese boride-silicon cermets can be fabricated and that such structures are stronger and more stable than calcium boride combinations. This appears to confirm the concept of bond density. It was found that manganese boride cermets exhibit very interesting paramagnetic properties which depend on the amount of boron introduced to the manganese. Manganese diboride is nonmagnetic, whereas manganese monoboride exhibits magnetic characteristics. Silicon boride cannot be synthesized by heating various mixtures of elemental silicon and elemental boron at 1400°C. Hot-pressing techniques can be successfully used in fabricating dense bodies of silicon and boron. These structures are oxidation resistant, and their transverse strengths are of the order of 40,000 psi. (auth)

6986

New York State Coll. of Ceramics, Alfred Univ.

AN INVESTIGATION OF A METHOD OF CASTING ALLOY-TITANIUM CARBIDE CERMETS. E. J. Soxman. Dec. 1953. 31p. Contract W33(038)ac-14233. (WADC-TR-53-370; AD-27514)

Equipment was constructed and used for the purpose of

developing a method for the casting of cermets. This method involved the dispersion of a ceramic material, liquid or solid, in molten metal. This apparatus was called the turbo-crucible. In its final version, the turbo-crucible consisted of a twelve pound capacity tilting induction furnace positioned in such a way that a graphite rotor mounted on a standard drill press head and driven by a variable speed motor could be lowered into the charge in the crucible, then withdrawn. The charge could be cast into a suitable mold by tilting the furnace. Using this equipment a dispersion of titanium carbide in nickel was obtained. The microstructures of such specimens are discussed and compared with the microstructures of similar charges melted in graphite crucibles. (auth)

CORROSION

6997

Rock Island Arsenal Lab.

RUST PREVENTIVES, DEVELOPMENT OF IMPROVED TEST METHODS. REPORT NO. 19. RADIOMETRIC EVALUATION OF THE WATER DISPLACING EFFICIENCIES OF VARIOUS SURFACTANTS. J. E. Smallwood. Oct. 14, 1952. 35p. (RIA-52-3790)

A procedure using a radiometric method developed at this Arsenal was utilized to evaluate the water-displacing ability of a large number of commercial surfactants. These surfactants were tested at various concentrations in Stoddard solvent to determine the minimum concentrations for effective water displacement from steel. (auth)

6988

TRANSPORTATION OF MATTER AND RADIOACTIVITY BY IONIZED AIR CORROSION. W. Primak and L. H. Fuchs (Argonne National Lab., Lemont, Ill.). *Phys. Today* 7, 15-16(1954) Sept.

Reactions involved in the radiation chemistry of the atmosphere are reviewed. Topics discussed include the fixation of N under conditions of ionization, the corrosion of a metal located in air subjected to intense radiation, the transportation of corrosion products, and the nuisance value of these products. (C.H.)

6999

CORROSION CONTROL BY ANODIC PROTECTION. C. Edeleanu (Firth-Brown Research Labs., Sheffield, England). *Metallurgia* 50, 113-16(1954) Sept.

Cathodic protection has been widely applied as a means of preventing the corrosion of certain metals because it is almost foolproof. Anodic protection, on the other hand, is only applicable under special conditions, but it is capable of spectacular results, such as the protection of stainless steel used as a boiler for sulfuric acid solutions. (auth)

GEOLOGY AND MINERALOGY

6990

Health and Safety Lab., New York Operations Office, AEC
MATHEMATICAL EVALUATION OF AIRBORNE RADIOLOGICAL SURVEY DATA. Ole Pedersen. Aug. 12, 1954. 8p. (NYO-4577(rev.))

Equations for the evaluation of radiation levels encountered in airborne radiological surveys in terms of an isolated circular source of finite radius and uniform surface radioactivity on the earth's surface and an expression for the surface activity of a cylindrical body of homogeneous radioactive material are derived. (auth)

8991

IDENTIFICATION OF MINERAL GRAINS BY SURFACE COLOURATION. Paul Raffinot. Translated by L. D. Muller from *Rev. ind. Minerale* 34, 1025-30(1953). 10p. (AERE-Trans-11/3/5/442)

6992

GEOLOGY OF THE SHINARUMP NO. 1 URANIUM MINE, SEVEN MILE CANYON AREA, GRAND COUNTY, UTAH. W. I. Finch (U. S. Geological Survey, Washington, D. C.). U. S. Geol. Survey Circ. 336, 1954, 14p.

The geology of the Shinarump No. 1 uranium mine, located in the Seven Mile Canyon area, Grand Co., Utah, was studied to determine the habits, ore controls, and possible origin of the deposit. Rocks of Permian, Triassic, and Jurassic age crop out in the area mapped, and uranium deposits are found in three zones in the lower 25 ft of the Chinle formation of Late Triassic age. The Shinarump No. 1 mine, which is in the lowermost zone, is located on the west flank of the Moab anticline near the Moab fault. The Shinarump No. 1 uranium deposit consists of discontinuous lenticular layers of mineralized rock, irregular in outline, that, in general, follow the bedding. Ore minerals, mainly uraninite, impregnate the rock. High-grade ore seams of uraninite and chalcocite occur along bedding planes. Uraninite and chalcocite are concentrated in the more poorly sorted parts of siltstones. In the Seven Mile Canyon area guides to ore inferred from the study of the Shinarump No. 1 deposit are the presence of bleached siltstone, carbonaceous matter, and copper sulfides. Results of spectrographic analysis indicate that the mineralizing solutions contained important amounts of barium, vanadium, uranium, and copper, as well as lesser amounts of strontium, chromium, boron, yttrium, lead, and zinc. The origin of the Shinarump No. 1 deposit is thought to be hydrothermal. (auth)

5993

MICROSCOPIC STUDIES OF URANIFEROUS COAL DEPOSITS. James M. Schopf and Ralph J. Gray (U. S. Geological Survey, Washington, D. C.). U. S. Geol. Survey Circ. 343, 1954, 10p.

Quantitative coal petrologic studies have been completed on 4 beds of uranium-bearing lignite from the Slim Buttes area of Harding County, S. Dak. Comparison of analyses of these deposits with analyses of lignite from commercial deposits suggests that the Slim Buttes coal deposits are highly diverse in composition. Relative to most coal deposits, however, all of the Slim Buttes coal that was studied has an unusually high uranium content. The studies show that no quantitative correlation exists between uranium content and the coal petrologic constituents that are normally determined for coal-type classification and for prediction of coal behavior in utilization. As the coal constituents normally determined are to some extent heterogeneous, a further study was made of subordinate components. The components of translucent attritus were studied particularly, not only for selected layers of Slim Buttes lignite but also for layers of coal from the Goose Creek field in southern Idaho. These data are presented for 11 layers of relatively high uranium content and for 8 associated layers that are much less radioactive and approach values that are about normal for coal. The results of this comparison cast doubt on direct correlation of uranium content with the amount of any single microscopic component of coal. A more complex

control of uranium occurrence in coal is indicated. It may be significant that the samples richest in uranium contain relatively large amounts of humic attritus matter resulting from decomposition and microbial decay. One may tentatively conclude that this type of organic material is most favorable to uranium emplacement. (auth)

8994

RADIOACTIVITY RECONNAISSANCE OF PART OF NORTH-CENTRAL CLEAR CREEK COUNTY, COLORADO. John D. Wells and Jack E. Harrison (U. S. Geological Survey, Washington, D. C.). U. S. Geol. Survey Circ. 345, 1954, 9p.

A radioactivity reconnaissance of 334 localities in north-central Clear Creek Co., Colo., made with a portable scintillation counter and a portable survey meter with a 6-in. gamma-beta Geiger tube, disclosed that seven of the localities contain sufficient uranium to warrant some physical exploration. Within the area studied, the localities containing chalcopyrite have the highest grade and highest percent of occurrences of significant abnormal radioactivity. Zones of galena-sphalerite veins have approximately the same rate of occurrence of significant abnormal radioactivity as zones of galena-sphalerite with chalcopyrite. Any locality or zone containing pyritic-type veins without chalcopyrite is considered unlikely to contain a uranium deposit. (auth)

6995

AN X-RAY STUDY OF NATURAL MONAZITE: I. M. D. Karkhanavala and J. Shankar (Atomic Energy Commission, Bombay, India). *Proc. Indian Acad. Sci.* 40A, 67-71(1954) Aug.

Four samples of monazite from India and Brazil were analyzed by x-ray diffraction, and diffuse powder diffraction patterns were obtained, even after very long exposures. The results obtained for the samples of known Th content indicate that monazite occurs in a fairly high degree of metamictization. (K.S.)

5996

ECONOMICS OF PRODUCING URANIUM ON THE COLORADO PLATEAU. *Nucleonics* 12, No. 10, 47(1954) Oct.

Typical costs for exploration programs, mining, transportation, and milling of U are summarized. (C.H.)

METALS AND METALLURGY

6997

Atomic Energy Research Establishment, Harwell, Berks (England)

THE SURFACE TOPOGRAPHY OF DIFFUSION COUPLES. R. S. Barnes. Mar. 12, 1954. 17p. (AERE-M/R-1396)

The free surfaces of diffusion couples have been examined microscopically and with x rays, and the observed features related to the behavior of the underlying metal. The voids, which form near to the interface in the faster diffusing metal, produce pits in the surface when they are revealed by the evaporation of the metals, which occurs during the anneal. Within the diffusion zone surface steps occur at grain boundaries, and the surfaces of the grains are rippled. Rippling in copper/nickel couples has been studied in detail, and the line of the ripples found to correspond to the intersection with the surface of a {110} plane in the grain. It is suggested that the ripples are caused, on the nickel-rich side of the interface, by the insertion of a series of adjacent parallel {110} atomic planes and, on the

copper-rich side, by the elimination of a similar series of planes. The edge dislocation configuration, already proposed, could produce such an effect when in the presence of a nonequilibrium number of atomic defects, such as occurs during intermetallic diffusion. (auth)

6998

Aeronautical Materials Lab., Naval Air Experimental Station, Philadelphia
SEAM WELDING OF ALUMINUM ALLOYS. Gerard H. Boss. June 11, 1947. 97p. (AML-NAM-2543(pt.2))

7000

Aeronautical Materials Lab., Naval Air Experimental Station, Philadelphia
AN INVESTIGATION OF THE BRAZING OF ALUMINUM ALLOY PARTS. J. G. Ballingall. May 5, 1950. 17p. (AML-NAM-AE-25685; U-11467)

Results are presented from a study to secure information from the literature on the subject of brazing of aluminum alloys, tests to determine the applicability of the process to aircraft construction and repair, and a determination of the tests necessary for specification requirements to control and evaluate the quality of brazed joints. (auth)

7000

North American Aviation, Inc.
LEAD-BISMUTH EUTECTIC THERMAL CONVECTION LOOP. Roman Cygan. Oct. 15, 1954. 11p. Contract AT(04-3)-49. (NAA-SR-1060)

A thermal convection loop of low-carbon steel using lead-bismuth eutectic has achieved a relatively long operating time by employing a trap containing a permanent magnet. A fair correlation between observed corrosion and the residues found has been obtained. The maximum operating temperature of the system was 850°F. (auth)

7001

Armour Research Foundation
DEVELOPMENT OF TRANSFORMATION DATA FOR SPECIAL TITANIUM ALLOYS. INTERIM TECHNICAL REPORT NO. 2 [FOR] NOVEMBER 1, 1953-FEBRUARY 28, 1954. W. H. Graft and W. Rostoker. Apr. 22, 1954. 32p. Contract DA-11-022-ORD-1292. (NP-5344)

The isothermal transformation characteristics of a titanium alloy containing 5% chromium and 3% aluminum have been studied. The investigation included the establishment of a TTT chart, metallographic examination of transformed structures, and the measurement of tensile and impact properties of transformed specimens. Some correlation between mechanical properties and structure was recognized. Heat treatment conditions for optimum combinations of tensile and impact properties were established. In addition, heat treatment conditions which induce brittleness were recognized. (For preceding period see NP-5071.) (auth)

7002

California Univ., Los Angeles
THE STRESS HARDNESS RELATION. FINAL REPORT 54-76. A. O. Dervishyan, E. Janssen, and W. C. Hurty. Sept. 1954. 40p. Contract [DA-04-495-ORD-310]. (NP-5346)

7003

[Crane Co.]
RELAXATION BEHAVIOR OF TITANIUM ALLOYS. QUARTERLY PROGRESS REPORT NO. 1. E. A. Sticha. July 15, 1954. 8p. Contract AF-33(616)-2400. (NP-5351)

As a means of affecting significant weight savings in

aircraft, the use of titanium alloys for bolting has been suggested. An application of this type requires, among other things, knowledge of relaxation behavior of the titanium alloys which might be utilized for bolts. The program developed for these alloys calls for six relaxation tests of 250 to 350 hr duration on each alloy and two tests at 60 and 80%, respectively, of the average 0.2% offset yield stress at each of three temperatures, namely, 400, 600, and 800°F. (auth)

7004

Chance Vought Aircraft, Inc.
EVALUATION OF THE PROPERTIES OF RC-130-A TITANIUM ALLOY SHEET. REPORT NO. 8880. M. D. Flanagan, A. J. McCulloch, and R. R. Pitts. [1954] 221p. Contract NOa(s)-51-751c. (NP-5354)

7005

Laboratories for Research and Development, Franklin Inst.
[SELF-DIFFUSION IN ZINC]. ANNUAL PROGRESS REPORT. [Frank E. Jaumot, Jr. and Raymond L. Smith]. Sept. 1954. 62p. Contract AT(30-1)-1484. (NYO-6112)
Self-diffusion in zinc has been used as an instrument for comparison of the absorption and sectioning techniques as a means of studying diffusion. Single crystal as well as polycrystal samples were used, and the temperature range of diffusion extended from 100 to 415°C. The effect on the values of the diffusion coefficient of electroplating versus evaporation as a means of applying the tracer was investigated, and no significant difference observed. It was found that an excess or defect of tracer did not materially affect the results obtained from the sectioning technique but invariably caused erroneous results for the absorption technique. For temperatures above 200°C, the data indicate that the results obtained from the absorption technique agree with those obtained from the sectioning technique. The data also agree with those of Shirn and co-workers. For diffusion below 200°C, anomalous results were obtained which are presumed to be caused by low-angle lineage boundaries in the single crystals. The data at low temperatures yield anomalously high values for the diffusion coefficient irrespective of whether it is considered to be volume or grain-boundary diffusion. Additional experiments designed to delineate the role of the low-angle boundaries are described. (auth)

7006

Armour Research Foundation
A STUDY OF A FAMILY OF LAVES-TYPE INTERMEDIATE PHASES. Rodney P. Elliott. Aug. 23, 1954. 70p. Contract AF 18(600)-642, Technical Report No. 1. (OSR-TN-54-247)

The transition elements were surveyed to determine in which systems Laves-type AB₂ phases occur. These findings show that a critical d_A/d_B ratio is necessary for the existence of a Laves-type phase but is not sufficient to govern its existence. Other factors, probably electronic in nature, must also be taken into consideration. Experimental data have been analyzed in terms of the parameter used by Berry and Raynor. Agreement is good and self consistent, but such an examination does not permit any detailed analysis of fundamental significance. It is felt that these curves are merely ramifications of Vegard's Law, according to which lattice parameters are distorted because of an improper size ratio. That there is a consistent decrease in the atomic diameters compared to the

elemental state (as is evidenced by the intersection of the distortion of the A-A and B-B bonds at negative distortion values) is felt to be the only significant conclusion of such an examination. It has been shown that the d_A/d_B ratio does not govern the particular Laves-type modification that occurs but that there is a trend for the $MgCu_2$ structure to occur at lower electron:atom ratios and the $MgZn_2$ structure to occur at higher electron:atom ratios if it is hypothesized that there is a variation to higher valency and then to lower valency as the first transition series is traversed from chromium to nickel. (auth)

7007

New York State Coll. of Ceramics, Alfred Univ.
IRON BONDED TITANIUM CARBIDE. Roger E. Wilson.
Dec. 1953. 38p. Contract W33(038)ac-14233. (WADC-TR-53-369; AD-29399)

The development of techniques for the hot pressing of various shapes necessary for determining the physical properties of Fe-TiC cermets and the determination of these properties are reported. From these properties it is concluded that the iron-titanium carbide cermet is inferior to nickel-titanium carbide cermets. (auth)

7008

New York Univ. Coll. of Engineering
TITANIUM PHASE DIAGRAM STUDY. INTERIM TECHNICAL REPORT NO. 1 [FOR OCTOBER 1, 1953 TO JANUARY 31, 1954]. P. Farrar, W. Kirk, and L. Stone.
33p. Contract DA-30-069-ORD-1216. (WAL-401/214)

The Ti-rich corner of the ternary systems Ti-Cr-V, Ti-Si-C, and Ti-N-H is described. A literature survey was completed, and anticipated isothermal sections are shown. Ninety-six alloys containing up to 40 wt.% total alloying addition were prepared to delineate the phase system Ti-C-V from 500°C to the solidus. Sixty-one alloys containing up to 24 wt.% Si and 4.8 wt.% C were prepared to delineate the phase system Ti-Si-C from 700 to 1400°C. A literature survey of the system Ti-N-H was completed. (J.E.D.)

7009

New York Univ. Coll. of Engineering
TITANIUM PHASE DIAGRAM STUDY. INTERIM TECHNICAL REPORT NO. 2. P. Farrar, W. Kirk, and L. Stone.
June 30, 1954. 31p. Contract DA-30-069-ORD-1216. (WAL-401/214-1)

Tentative partial isothermal sections of Ti-Cr-V alloys were constructed at 800 and 650°C. Forty-five additional alloys, making a total of 141, have been prepared. As-cast and as-hot-rolled hardnesses have been obtained. Seven partial isothermal sections of Ti-Si-C systems were obtained between 700 and 1300°C in the composition range from 0 to 24 wt.% Si and 0 to 4.8 wt.% C. As-cast hardnesses were obtained, and the solubility limit of silicon in beta titanium was rechecked. The apparatus to be used in the delineation of the Ti-N-H system was completed. Results from the analysis of the titanium nitride powder were obtained, and tests to evaluate the production of hydrogen by electrolytic diffusion through palladium were concluded. (For preceding period see WAL-401/214.) (auth)

7010

FABRICATION OF A ZIRCONIUM-LINED REACTION VESSEL. O. G. Paasche (Bureau of Mines and Oregon State Coll., Corvallis, Ore.) and A. J. Killin (Bureau of Mines, Albany, Ore.). Welding J. (N. Y.) 33, 115-18(1954) Feb.

Successful welding of Zr was accomplished by the inert-gas shielded process with additional protection by inert gas on the underside of the weld. (L.T.W.)

7011

SILVER BRAZING ALLOYS FOR CORROSION-RESISTANT JOINTS IN STAINLESS STEELS. George H. Sistare (Handy and Harman, Bridgeport, Conn.), John J. Halbig (Armco Steel Corp., Middletown, Ohio), and L. H. Grenell (General Motors Corp., Dayton, Ohio). Welding J. (N. Y.) 33, 137-43(1954) Feb.

Nickel-free silver brazing alloy joints on nickel-containing stainless steels have long been known to have little or no corrosion resistance when subjected to harshly corrosive, saline solutions. Nickel-containing silver brazing alloys were developed to meet these conditions. However, in the case of the nickel-free stainless steels, nickel-free silver brazing alloy joints are not resistant to mildly corrosive media, such as humid air or flowing tap water; even the conventional nickel-containing silver brazing alloy joint is not completely resistant. Evidently, a corrosion-resistant bond on nickel-free stainless steel depends upon the deposition of a nickel-rich layer from the brazing alloy over the entire area covered by the brazing alloy. Very few of the feasible nickel-containing silver alloys investigated can produce a complete deposit of this sort, but at least one type has been developed that will. The separation process appears to be a form of crevice corrosion that results from imperfections at the edge of the brazing alloy fillet. This in turn stems from oxygen-concentration cell activity in the presence of moisture. (auth)

7012

RESISTANCE SPOT WELDING OF TITANIUM AND ITS ALLOYS. A. J. Rosenberg (General Electric Co., Lynn, Mass.). Welding J. (N. Y.) 33, 324-8(1954) Apr.

The properties of spot-welded joints in Ti and its alloys are reported and compared with spot-welded joints in other materials. (L.T.W.)

7013

WELDING OF 90/10 COPPER-NICKEL ALLOY. G. R. Pease and T. E. Kihlgren (International Nickel Co., Bayonne, N. J.). Welding J. (N. Y.) 33, 329-38(1954) Apr.

Data are presented which indicate that iron-bearing 90/10 cupro-nickel can be satisfactorily welded by all of the currently important fusion welding processes. The important variables are defined, and suggested areas of usefulness are outlined for each of the several methods. Data include preferred weld composition, the effect of composition on strength and soundness, appropriate filler wire composition and shielding gas and flux requirements. The response to silver brazing methods is also treated briefly. (auth)

7014

OPTIMUM SPOT AND SEAM WELDING CONDITIONS FOR INCONEL X. Ernest F. Nippes and Herbert B. Fishman (Rensselaer Polytechnic Inst., Troy, N. Y.). Welding J. (N. Y.) 33, 18-14s(1954) Jan.

This research covers the determination of the optimum spot and seam welding conditions for 0.010-, 0.015-, 0.021-, 0.031-, and 0.062-in. Inconel-X sheet. Inconel X is a precipitation-hardening alloy for high-temperature use. The unique properties of Inconel X and their effect upon spot and seam welding are discussed. The procedure for the determination of the optimum conditions is outlined from

the standpoint of the limits imposed upon the welding variables by the RWMA criteria for spot and seam welding. These criteria are explained, and the interrelation of variables is discussed. The results of tension-shear and cross-tension tests for spot welds are shown and discussed. The pillow test was used for determination of the rupture strength of pressure-tight seam welds. The maximum rupture strength was found to be a linear function of sheet thickness. Since sufficient force was not obtainable with the available seam welding equipment, the optimum values for seam welding of 0.062-in. Inconel X could not be found. However, the effects of insufficient weld force are discussed. (auth)

7015

THE PLASTIC FATIGUE STRENGTH OF PRESSURE VESSEL STEELS. J. H. Gross, D. E. Gucer, and R. D. Stout (Lehigh Univ., Bethlehem, Penna.). Welding J. (N. Y.) 33, 31s-9s(1954) Jan.

A comparison was made of plastic fatigue properties of a high-strength steel and a carbon pressure-vessel steel including strain behavior, surface preparation, testing temperature, welding, and heat treatments. (J.E.D.)

7016

TRANSFORMATION OF Cr-Mo STEELS DURING WELDING. W. R. Applett, Jr., R. P. Dunphy, and W. S. Pellini (Naval Research Lab., Washington, D. C.). Welding J. (N. Y.) 57s-64s(1954) Jan.

The continuous cooling transformations of two chromium-molybdenum steels, one a nominal 1.25% Cr-0.5% Mo and the other a nominal 2.25% Cr-1.0% Mo, have been determined for austenitizing and cooling conditions simulating an actual weld. These steels undergo primarily a bainitic reaction, and the specific microstructural conditions which are developed depend principally on the austenitizing temperature and the degree of solution of the carbides. Preheating these steels to temperatures as high as 600° F for the purpose of obtaining softer transformation products in the heat-affected zone results in a relatively minor decrease in the maximum hardness developed. (auth)

7017

DESTRUCTION TESTS AND DESIGN DATA FOR WELDED PRESSURE VESSELS. John B. Custer (Aluminum Company of America, New Kensington, Penna.). Welding J. (N. Y.) 33, 65s-70s(1954) Feb.

The results of tests on Alcoa's Al alloy A54S (ASTM GR40A) to develop welding procedures and design data for fabrication of pressure vessels are reported. (L.T.W.)

7018

FACTORS WHICH INFLUENCE WELD HOT CRACKING. W. R. Applett and W. S. Pellini (Naval Research Lab., Washington, D. C.). Welding J. (N. Y.) 33, 83s-90s(1954) Feb.

The development of hot cracks in welds results from the combined effects of metallurgical and mechanical factors. Metallurgical factors relate to conditions of solidification of the metal, the grain size, presence of low-melting eutectic films, etc.; mechanical factors relate to conditions of strain (extension) developed in the weld metal during solidification as the result of differential cooling at various weld and near-weld positions. A hot cracking test was developed which evaluates the hot cracking susceptibility of weld deposits in terms of the severity of the mechanical conditions which are required to produce hot cracking. It is demonstrated that certain high-temperature alloys are inherently susceptible to hot cracking because of unfavor-

able conditions of solidification; such alloys require close control of welding procedures to prevent hot cracking. (auth)

7019

SOLDERING OF ALUMINUM. J. D. Dowd (Alco Aluminum Research Labs., New Kensington, Penna.). Welding J. (N. Y.) 33, 113s-20s(1954) Mar.

Aluminum and its alloys were found to be readily soldered once the oxide film on the surface was removed. This oxide can be removed mechanically by ultrasonic vibration, abrading with steel wool, wire-brushing, or by some similar means while the surface is covered with molten solder, or it can be removed with fluxes. A chloride-free organic flux is recommended for use with low-temperature solders. With high-temperature solders, it is necessary to use chloride fluxes, the residues of which should be completely removed to prevent subsequent corrosion of the aluminum. The resistance to corrosion of soldered joints in aluminum has been found to increase as the zinc content of the solder increases. The best solders from a corrosion viewpoint are zinc-base alloys in which zinc is the lowest melting metal. The resistance to corrosion of soldered joints has also been found to depend upon joint design, environment and effectiveness of protection. Sound soldered joints that are adequately protected have been found to give satisfactory service in various environments for many years. (auth)

7020

EFFECT OF ATMOSPHERIC CONTAMINANTS ON ARC WELDS IN TITANIUM. J. C. Barrett and L. R. Lane, Jr. (Federal Bureau of Mines, College Park, Md.). Welding J. (N. Y.) 33, 121s-8s(1954) Mar.

The effect of O, N, H, and water vapor on the physical properties of inert-gas-shielded W arc welds in Ti is discussed. (auth)

7021

FUSION WELDING OF COMMERCIAL PURE TITANIUM. Francis H. Stevenson (Aerojet-General Corp., Azusa, Calif.). Welding J. (N. Y.) 33, 147s-54s(1954) Mar.

The techniques for producing acceptable welds in commercially pure Ti and the superiority of certain techniques are discussed. (auth)

7022

LITERATURE SURVEY OF HIGH-STRENGTH STEELS. Welding J. (N. Y.) 33, 251s-6s(1954) May.

Composition and properties of American and European high-yield-strength steels studied by the Subcommittee of Pressure Vessel Research Committee are reviewed. (L.T.W.)

7023

EFFECT OF OXYGEN ON WELDING AND BRAZING MOLYBDENUM. Timothy Perry (A. P. V. Co., Ltd., London) and H. S. Spacil and John Wulff (Massachusetts Inst. of Tech., Cambridge). Welding J. (N. Y.) 33, 442s-8s(1954) Sept.

7024

JOINING OF MOLYBDENUM. James H. Johnston, Harry Udin, and John Wulff (Massachusetts Inst. of Tech., Cambridge). Welding J. (N. Y.) 33, 449s-58s(1954) Sept.

A literature survey is presented on the joining of Mo including fusion welding, butt-joining experiments, butt welding in air, brazing, spot welding, and riveted joints. (J.E.D.)

7025

SOME 12 PER CENT CHROMIUM ALLOYS FOR 1000 F TO 1200 F OPERATION. D. L. Newhouse, B. R. Seguin (General Electric Co., Schenectady, N. Y.), and E. M. Lape (General Electric Co., River Works, West Lynn, Mass.). Trans. Am. Soc. Mech. Engrs. 76, 1107-22(1954) Oct.

This paper presents a discussion of important engineering properties of some martensitic 12 per cent Cr alloys for use at temperatures up to 1200 F. Detailed high-temperature creep-relaxation and stress-rupture data are given for 12 per cent Cr (Type 403) and for six alloy modifications including 12 per cent Cr-Co-W-V, 12 per cent Cr-W-V, 12 per cent Cr-Mo-V, 12 per cent Cr-Mo-W-V, 12 per cent Cr-Cb, and 12 per cent Cr-Ni-W. Other properties such as thermal expansion, modulus of elasticity, resistance to stress corrosion, and so forth, are discussed. Some of the modified 12 per cent Cr alloys offer a combination of properties which makes them attractive for a number of high-temperature applications. (auth)

7026

RESULTS OF SERVICE TEST PROGRAM ON TRANSITION WELDS BETWEEN AUSTENITIC AND FERRITIC STEELS AT THE PHILIP SPORN AND TWIN BRANCH PLANTS. G. E. Lien (American Gas and Electric Service Corp., New York City), F. Eberle, and R. D. Wylie (Babcock and Wilcox Company, Alliance, Ohio). Trans. Am. Soc. Mech. Engrs. 76, 1075-83(1954) Oct.

A test program was set up to give advance operating information on the dissimilar-metal welds installed on the American Gas and Electric Company (AG&E) System in the units of the Philip Sporn Plant of Appalachian Electric Power Company, The Ohio Power Company, and in unit No. 5 of the Twin Branch Plant of the Indiana & Michigan Electric Company. After cycling weld-test vessels, small surface notches and subsurface cracks have formed at the fusion line between the austenitic weld metal and the ferritic pipe. The program and findings to date are described in this paper. (auth)

7027

CYCLIC HEATING TEST OF MAIN STEAM PIPING MATERIALS AND WELDS AT THE SEWAREN GENERATING STATION. H. Weisberg and H. M. Soldan (Public Service Electric and Gas Co., Newark, N. J.). Trans. Am. Soc. Mech. Engrs. 76, 1085-91(1954) Oct.

A description is given of cyclic heating tests of austenitic and ferritic piping and welds, representing the main steam piping installed at Seward Generating Station. In the current test, a section made up of these materials was subjected to thermal cycling from room temperature to 1100 F, and from atmospheric pressure to the operating pressure of 1500 psi. The heating and cooling rates were somewhat more severe than are experienced during regular starting and shutting-down conditions in the actual piping systems. The results show that 100 cycles did not produce any cracking. It is proposed to continue the test to destruction by further cycling and the addition of external bending forces. (auth)

7028

STRESS-RUPTURE PROPERTIES OF SOME CHROMIUM-NICKEL STAINLESS-STEEL WELD DEPOSITS. R. D. Wylie (Babcock and Wilcox Co., Barberton, Ohio), C. L. Corey (Univ. of Michigan, Ann Arbor), and W. E. Leyda (Babcock and Wilcox Research Center, Alliance, Ohio).

Trans. Am. Soc. Mech. Engrs. 76, 1093-1106(1954) Oct.

The Babcock & Wilcox Company has been conducting a test program on the high-temperature strength of chromium-nickel stainless-steel welded joints. The first work to be completed is data on the strength of all-weld-metal coupons of eleven compositions of commercial stainless-steel weld deposits. It is hoped that the data presented, together with those presented in subsequent discussion by other industrial organizations, will serve as a guide to the Subcommittee on Stress Allowances for Ferrous Materials of the ASME Boiler Code Committee in the selection of allowable stresses for the chromium-nickel stainless steels. (auth)

7029

DELTA-FERRITE-AUSTENITE REACTIONS AND THE FORMATION OF CARBIDE, SIGMA, AND CHI PHASES IN 18 CHROMIUM-8 NICKEL-3.5 MOLYBDENUM STEELS. H. C. Vacher and C. J. Bechtoldt (National Bureau of Standards, Washington, D. C.). J. Research Natl. Bur. Standards 53, 67-76(1954) Aug.

Three 18 Cr-8 Ni-3.5 Mo steels of slightly different compositions were given "solution treatments" at 2,500°, 2,000°, and 1,800° F, and samples of each were reheated at 1,700°, 1,500°, and 1,200° F. Ferrite residues, remaining after dissolving the austenite in the solution-treated steels were analyzed chemically and given the reheat treatments, along with the parent steels. A metallographic study of the effect of chemical composition of the delta ferrite and austenite phases, and of the amount of delta ferrite, on the formation of carbide, sigma, and chi phases, was made. It was found that the products formed at a certain reheating temperature were influenced by the amount and composition of the delta ferrite phase present in the solution-treated steels, the amount and composition of the delta ferrite being determined by the solution-treatment temperature. Distribution ratios for Cr, Ni, Mo, and Mn in the delta ferrite and austenite phases of the solution-treated steels were 1.2, 0.5, 1.7, and 0.9, respectively. (auth)

7030

THE CALCULATION OF HEATS OF FORMATION OF BINARY ALLOYS. J. H. O. Varley (Birmingham Univ., England). Phil. Mag. (7) 45, 887-916(1954) Sept.

A theoretical treatment for calculating the heats of formation of binary alloys for any composition is put forward. The model is based upon the assumption that the free electrons in a binary alloy exist in two sets of energy levels associated with the potential fields of the ions of the two elements in the alloy. This assumption is a natural consequence of neglecting the changes in the Wigner-Seitz boundary conditions, imposed upon the electrons in the pure elements, when the atoms are randomly mixed in an alloy. Fair agreement between calculated and experimental heats of formation is obtained for many systems, in which the two elements composing a given system are not too far removed from one another in the periodic classification of the elements. Some consequences of the theory are discussed, in particular the magnetic behavior of alloys can be qualitatively explained, the relative valency effect is also a natural prediction of the theory, and the observed dependence of Fermi band width on composition in some binary alloys is accounted for. (auth)

7031

SOME OBSERVATIONS ON THE KROLL PROCESS FOR TITANIUM. F. S. Wartman, Don H. Baker, J. R. Nettle, and

V. E. Homme (Bureau of Mines, Boulder City, Nev.). J. Electrochem. Soc. 101, 507-13(1954) Oct.

A series of small-scale Kroll process reductions, carried to varying degrees of completion, were opened and examined to obtain information concerning the mechanism of the reduction. Experiments made to determine the cause of zonal variations of hardness in the crude sponge made by the Kroll process indicate this effect is due largely to impurities in the magnesium. (auth)

7032

TIN INCREASES STRENGTH OF TI-AL ALLOYS WITHOUT LOSS IN FABRICABILITY. W. L. Finlay, R. I. Jaffee, R. W. Parcel, and R. C. Durstein (Rem-Cru Titanium, Inc., Midland, Penna.). J. Metals 6, 25-9(1954) Jan.

The fabrication characteristics of Al-Ti alloys containing several percent Sn were found to be little different from those of the alloys without Sn. Several percent Sn could be added without causing any loss in hot fabricability even though Sn addition effects a substantial strength increase in the alloy. (J.E.D.)

7033

MECHANISM OF PLASTIC FLOW IN TITANIUM; MANIFESTATIONS AND DYNAMICS OF GLIDE. F. D. Rosi (Sylvania Electric Products, Inc., Bayside, N. Y.). J. Metals 6, 58-69(1954) Jan.

The slip and twinning behavior in extended titanium crystals was studied in some detail. The formation and appearance of coarse kink bands are discussed. Their crystallographic geometry was determined by x-ray analysis. A phenomenological interpretation of the complexities in kink band development is also presented. The critical resolved shear stress, coefficient of shear hardening, and plane of fracture were determined for several crystals extended at room temperature. (auth)

7034

REACTION OF OXYGEN AND NITROGEN WITH TITANIUM FROM 700° TO 1050°C. Lee S. Richardson and Nicholas J. Grant (Massachusetts Inst. of Tech., Cambridge). J. Metals 6, 69-70(1954) Jan.

A study of reactions of O₂ and N at low pressures with Ti was made. The decrease in O₂ pressure for tests at 0.5 atm. at various temperatures as a function of the square root of the time is shown. Deviations from linearity are minor, and the parabolic rate law is obeyed. The same plot for the N reaction is shown. A definite deviation from linearity is noted. (J.E.D.)

7035

RARE EARTHS COUNTERACT HOT ROLLING DEFECTS IN STAINLESS STEEL. R. H. Henke and R. A. Lula (Allegheny Ludlum Steel Corp., Brackenridge, Penna.). J. Metals 6, 883-8(1954) Aug.

The rollability of stainless steel is determined by metallurgical factors and the type of equipment available. The metallurgical factors which are discussed include the structure and grain size of the ingot, pouring temperature, influence of various small additions, and the solidification of the alloy in the ferritic or austenitic phase. Martensitic and ferritic steels were found to roll easily and do not require rare earth additions. Austenitic steels are more difficult to hot roll due to a duplex ferrite and austenite formation. The inherent hot shortness of higher alloyed steels can be counteracted by the addition of rare earth and rare earth oxides. This improvement appears to be

related to the increased ductility at the rolling temperature. (J.E.D.)

7036

COLUMBIUM-VANADIUM ALLOY SYSTEM. H. A. Wilhelm, O. N. Carlson, and J. M. Dickinson (Iowa State Coll., Ames). J. Metals 6, 915-18(1954) Aug.

On the basis of microscopic studies, melting-point observation, and X-ray analyses, a phase diagram is proposed for the Nb-V system. A complete series of solid solutions is formed with a minimum in the solidus at 1810°C near 35 wt % Nb. No compounds or intermediate phases were found in the system above 650°C. (auth)

7037

HOT PRESSING, PRESS FORMING LOOM AS ANSWERS TO TITANIUM FABRICATION. H. W. Dodds and G. F. Davies (Brush Labs. Co., Cleveland, Ohio). J. Metals 6, 1116-18(1954) Oct.

As a result of the properties observed in both hot pressing and press forming in notched and unnotched fatigue, energy absorption tests, and tension tests, it appears that Ti-Brush 40 as fabricated by powder metallurgy is a significant material of construction. The low utilization factor realized through Ti powder metallurgy means saving in manpower required for machining and materials required for production plus a low scrap loss. In billet form it appears comparable to arc-melted stock for extrusion, drawing or forging. As a fabricated shape its usefulness is enhanced by a high degree of uniformity characteristic of most powder metal parts. (J.E.D.)

7038

PHASE TRANSFORMATIONS IN TITANIUM-RICH ALLOYS OF IRON AND TITANIUM. D. H. Polonis and J. Gordon Parr (Univ. of British Columbia, Vancouver, Canada). J. Metals 6, 1148-54(1954) Oct.

High purity alloys of titanium and iron, made by a technique of levitation melting, have been investigated with particular reference to martensite formation and decomposition in the hypoeutectoid range. A preliminary study has been made of the occurrence of the phase corresponding to the structure Ti₂Fe. (auth)

7039

RARE EARTHS IN STAINLESS STEELS. Howard O. Beaver (Carpenter Steel Co., Reading, Penna.). Metal Progr. 66, No. 4, 115-19(1954) Oct.

The effects of rare earth oxide and misch metal additions on high Cr-Ni austenitic steels was studied. Hot workability is improved by proper choice of additions, except in the hot short types where only residual Ce or La proved helpful. Beneficial effects have been noted on tramp elements, on high Mo and/or Cu contents, and on O₂ and H₂ removal. Tensile strength, corrosion resistance, impact strength, and age hardening are unaffected. Stress-rupture strength is definitely increased, and scaling resistance up to 1900°F is increased; however, above this temperature the scaling rate increases rapidly. (L.M.T.)

7040

HYDROGEN EMBRITTLEMENT OF A TITANIUM ALLOY. R. J. Kotfila and E. F. Erbin (Wright Air Development Center, Dayton, Ohio). Metal Progr. 66, No. 4, 128-31(1954) Oct.

Recent failures of titanium alloy components have been ascribed to hydrogen, and it is demonstrated here that this interstitial element lowers the tensile ductility

of the 3% manganese complex alloy, the effect becoming most pronounced with decreasing strain rate at room temperature. (auth)

PHYSICS

7041

Laboratory for Nuclear Science, Mass. Inst. of Tech. ANNUAL PROGRESS REPORT. [PROGRESS REPORT NO. 33 FOR PERIOD JUNE 1, 1953 TO MAY 31, 1954]. May 31, 1954. 191p. Contracts AT(30-1)-905 and N5ori-07806. (AECU-2943)

Separate abstracts have been prepared for four parts of this report. (J.S.R.)

7042

Laboratory for Nuclear Science, Mass. Inst. of Tech. COSMIC RAY GROUP; ELEMENTARY PARTICLE SCATTERING GROUP; AND NEUTRON PHYSICS GROUP. p.53-75 of ANNUAL PROGRESS REPORT. [PROGRESS REPORT NO. 33 FOR PERIOD JUNE 1, 1953 TO MAY 31, 1954]. May 31, 1954. 23p. Contract N5ori-07806. (AECU-2943(p.53-75))

Cosmic Ray Group. Preliminary tests of the operating characteristics of the new multiplate cloud chamber were made. Some results from the analysis of 8-particle decay are presented. Three events in which a V^0 seems to come from the point of stopping of a heavy primary particle is interpreted as the nuclear absorption of a negative K particle according to the process $K^- + n \rightarrow \Lambda^0 + \pi^-$. Three possible interpretations are given for a heavy particle which was observed in a cloud chamber coming to rest and producing three electron cascades with no other visible product. The spectrum of electrons from the decay of the μ meson may be written $P(E)dE = 4E^2/W [3(W-E) + 2\rho(\frac{2}{3}E-W)]dE$, where W is the maximum possible electron energy and ρ is a parameter with the value 0.50 ± 0.12 . The (γ, n) yields of As^{75} , Cu^{65} , Fe^{54} , and Zn^{64} relative to $Cu^{63}(\gamma, n)$ are tabulated. The excitation curve for the reaction $In^{115}(\gamma, \gamma') In^{115m}$ was measured from 2 to 14 Mev using a stacked foil technique. Studies on the photofission of Th^{232} , U^{235} , and U^{238} have continued. Neutron Physics Group. V, Cr, Mn, Zr, Nb, In, Sn, I, and Cs were bombarded with protons at various energies in a search for low-lying energy by electric excitation. Preliminary results indicate that the 136.5 kev first rotational level in Ta can be excited by 1.1-Mev neutrons. The inelastic scattering of neutrons by the NaI(Tl) crystal was studied. (J.S.R.)

7043

Laboratory for Nuclear Science, Mass. Inst. of Tech. ONR GENERATOR GROUP AND RADIOACTIVITY GROUP. p.76-114 of ANNUAL PROGRESS REPORT. [PROGRESS REPORT NO. 33 FOR PERIOD JUNE 1, 1953 TO MAY 31, 1954]. May 31, 1954. 39p. Contract N5ori-07806. (AECU-2943(p.76-114))

ONR Generator Group. The energy levels and Q values of Be^{10} from the reaction $Be^9(d, p)Be^{10}$ were measured. The proton groups observed when thin targets of Formvar, polyethylene, and Nylon are bombarded by deuterons with energies from 5 to 8.5 Mev have been assigned to levels in C^{13} , C^{14} , N^{15} , and O^{17} . Attempts to corroborate reports of a 0.7-Mev level in C^{13} from the $B^{10}(\alpha, p)$ reaction and of a 0.4-Mev level in Na^{22} from the $F^{19}(\alpha, p)$ reaction were unsuccessful. The energy levels of Al^{26} and Al^{27} were measured.

Energy levels of Ca^{40} , Ca^{41} , Ca^{42} , Ca^{45} , and K^{39} are reported. Radioactivity Group. The ground state splitting of positronium was measured with an accuracy 10 times greater than that achieved previously. Double β decay in Ca^{46} was investigated. The evidence seemed to indicate that β - β decay can occur without neutrino emission. (J.S.R.)

7044

Laboratory for Nuclear Science, Mass. Inst. of Tech. CYCLOTRON GROUP; SYNCHROTRON GROUP; AND THEORETICAL GROUP. p.115-58 of ANNUAL PROGRESS REPORT. [PROGRESS REPORT NO. 33 FOR PERIOD JUNE 1, 1953 TO MAY 31, 1954]. May 31, 1954. 44p. Contract N5ori-07806. (AECU-2943(p.115-58))

Cyclotron Group. The low-energy proton spectra obtained from bombarding U^{238} , Pb^{208} , Ta^{181} , Sb, Ag, and Nb⁹³ with deuterons are given. Synchrotron Group. The angular distribution of π^0 from $\gamma + He^4 \rightarrow He^4 + \pi^0$ and of He^3 from $\gamma + He^4 \rightarrow n + He^3$ are reported. The yields of deuterons and tritons relative to the proton yield from Be, C, and Pb bombarded with 300-Mev bremsstrahlung were determined at 45°, 90°, and 135°. The design and performance of two γ counters for use above 50 Mev are described. Preliminary measurements at 90° and 135° of the absolute γ scattering cross section for Be, C, Al, Cu, Sn, Pb, and Bi in the energy range from 35 to 130 Mev are reported. Theoretical Group. The significance of the electromagnetic self-energy of elementary particles was reinvestigated in connection with Feynman's new theory of the proton-neutron mass difference. Using a phenomenological interaction, the angular distribution and total cross section were calculated for the reaction $p + p \rightarrow \pi^+ + d$. (J.S.R.)

7045

Atomic Energy Research Establishment, Harwell, Berks (England) DISTRIBUTION OF EVAPORATED FILMS FROM LINEAR SOURCES. J. G. S. Biram. Apr. 6, 1954. 17p. (AERE-EL/R-1394)

The distribution of film thickness obtained from rod-type heaters used in vacuum evaporation is considered, and the conditions under which heater length can be neglected are given. The expressions for this distribution are used to find the absolute thickness at any point on the target when the mass per unit area of film is known. (auth)

7046

European Council for Nuclear Research ON THE CORRECTION OF MAGNETIC FIELD PLOTS FOR FINITE PERMEABILITY. G. Luders. Sept. 1954. 7p. (CERN-PS/GL-12)

A method is outlined which allows one to give the correction for finite values of the permeability of the iron to magnetic field plots obtained originally under the assumption of infinite permeability. One starts with the field distribution in air for infinite permeability of the iron and subsequently two potential problems have to be solved, the first one for the flux distribution in the iron and the second one for a corrective term to the magnetic field in the air. Standard methods can be applied for solving the potential problems. The result is only approximative; it can be understood as the first term of a serious expansion in terms of $1/\mu$. By a slight modification, the method can also be used to obtain, for measured field distributions (i.e., for finite μ), their dependence on the permeability. (auth)

7047

Carbide and Carbon Chemicals Co. (K-25)
 THE THERMAL PROPERTIES OF TWO-DIMENSIONAL PHASES. W. C. DeMarcus, J. N. Dyer, and E. H. Hopper. Oct. 11, 1954. 52p. Contract W-7405-eng-26. (K-1146)

The thermal properties of two-dimensional phases are investigated on the assumption that any two molecules interact with a potential given by the well-known Lennard-Jones 6-12 function. The critical constants of the two-dimensional gas obtained agree well with those obtained by Devonshire. The two-dimensional solid was also investigated, but techniques are not accurate enough to say whether there is a true first-order phase change, liquid-solid. (auth)

7048

Carbide and Carbon Chemicals Co. (K-25)
 THE HEAT OF DISSOCIATION OF NITROGEN AND THE APPEARANCE POTENTIAL OF SOME IONS FORMED IN FLUORINE AND HYDROGEN FLUORIDE BY ELECTRON IMPACT. John Francis Burns. Oct. 8, 1954. 114p. Contract W-7405-eng-26. (K-1147)

The retarding potential method for the measurement of appearance potentials has been used for an investigation of the heat of dissociation of nitrogen. It has been shown that this method permits the resolution of the separate ion currents arising from different dissociation processes and makes it possible to assign the original onset of ion current to a definite dissociation process. The results of the present measurements lead to a value of 9.76 eV for the value of the dissociation energy of nitrogen. Values of 16.38 and 16.5 eV have been obtained for the electron energy necessary to form the positive molecular ion in hydrogen fluoride and fluorine, respectively. Some measurements have been made on the negative fluorine ions resulting from the dissociation of hydrogen fluoride and fluorine. (auth)

7049

North American Aviation, Inc.
 MECHANISM OF PORE FORMATION ASSOCIATED WITH THE KIRKENDALL EFFECT. John A. Brinkman. Oct. 1, 1954. 19p. Contract AT-11-1-GEN-8. (NAA-SR-1022)

It is shown that a two-dimensional tensile stress is established in Kirkendall-type diffusion specimens on the side of the interface suffering a net loss of atoms. In the presence of this stress, voids larger than a critical size will grow by absorbing vacant lattice sites when the concentration of such sites is maintained at its equilibrium value. A mechanism is proposed by which the tensile stress can nucleate voids of this critical size or larger. Thus the proposed mechanism of nucleation and growth of the voids formed in connection with Kirkendall-type diffusion experiments can operate without the existence of an excess concentration of vacancies. (auth)

7050

Illinois Inst. of Tech.
 ELECTRON DIFFRACTION STUDIES OF FRICTION. P. L. Copeland and E. J. Scheibner. June 1954. 67p. Contract [AF-18(600)-643], Technical Report No. 1. (OSR-TR-54-18)

The nature of the frictional wear of single crystal and polycrystalline materials is determined primarily by electron diffraction methods. The current viewpoint of the friction mechanism is reviewed as well as methods for studying friction. A theory is developed for the interpretation of single crystal electron diffraction patterns from imperfect crystals based upon the intensity distribution in reciprocal

space and the use of the Ewald sphere to determine possible reflections. A report on studies of frictional behavior for polycrystalline materials sliding on polycrystalline materials and for single crystals sliding on single crystal and polycrystalline materials is made. It is concluded that the electron diffraction method is sufficiently sensitive to detect fracturing of the crystal surface and for identifying material transferred during sliding. For copper, the presence of a thin oxide film tends to reduce the coefficient of friction, but it does not prevent the deformation of the copper crystal. (auth)

7051

THE DEPENDENCE OF THE VELOCITY OF DROPS ON THE VELOCITY OF THE MEDIUM. (Skorost' Dvizheniya Kapel' V Zavisimosti Ot Skorosti Dvizheniya Sredy). N. I. Smirnov and V. L. Ruban. Translated by M. Goyer from Zhur. Priklad. Khim. 22, 1211-13(1949). 6p. (RAE-Trans-371; AEC-tr-1405)

For drops moving through a fluid in motion the determination of the velocity relative to the walls of the tube is of considerable interest in ascertaining the moment when the tube becomes choked, i.e., the movement when the velocity is reduced to zero owing to the high velocity of the medium. (auth)

7052

VIBRATIONAL ANHARMONICITY AND LATTICE THERMAL PROPERTIES. J. S. Dugdale and D. K. C. MacDonald (National Research Council, Ottawa, Canada). *Phys. Rev.* 96, 57-62(1954) Oct. 1.

It has been believed for some time that anharmonicity of lattice vibrations is responsible for the continued rise of the specific heats of certain solids in the classical temperature region. A general analysis is carried out of the linear chain model interacting through a Morse potential. All the major thermal properties such as specific heats, thermal expansion, and compressibility are derived, and a tentative comparison is made with observed properties of the alkali metals. It is found that the linear chain then exists in two widely different states with properties characteristic of condensed and gas-like phases; these two states are separated by a relatively narrow transition region in temperature where the specific heat passes through a rather sharp maximum (except at high pressures when the maximum ultimately disappears). (auth)

7053

PROBABILITY CURVES NEAR THRESHOLD FOR THE FORMATION OF He^+ , Ne^{++} , A^{++} , Kr^{++} , AND Xe^{++} BY ELECTRON IMPACT. W. M. Hickam, R. E. Fox, and T. Kjeldas, Jr. (Westinghouse Research Labs., East Pittsburgh, Penna.). *Phys. Rev.* 96, 63-5(1954) Oct. 1.

The formation of He^+ , Ne^{++} , A^{++} , Kr^{++} , and Xe^{++} as a function of electron energy is studied with essentially monoenergetic electrons. The He^+ curve obtained in this way for an energy range of eight volts above the ionization threshold does not exhibit any detectable departure from linearity. The accuracy is such that the difference between a 1.0 and 1.1 power curve is detectable for this energy range. The ionization probability curves of the doubly charged ions is interpreted as the superposition of linear excitation curves arising from each of the $^3\text{P}_2$, $^3\text{P}_1$, $^3\text{P}_0$, $^1\text{D}_2$, and $^1\text{S}_0$ states of the ions. (auth)

7054

IDENTIFICATION OF GADOLINIUM AND TERBIUM RADIOISOTOPES AS FISSION PRODUCTS OF U^{235} . E. C.

Freiling, L. R. Bunney, and N. E. Ballou (U. S. Naval Radiological Defense Lab., San Francisco, Calif.). *Phys. Rev.* **96**, 102(1954) Oct. 1.

The identification of Cd^{109} and Tb^{151} as products of the neutron-induced fission of U^{235} has been confirmed. By a comparison of counting rates with Mo^{99} , the fission yields have been estimated to be 1.1×10^{-3} and 8×10^{-3} percent, respectively. (auth)

7055

X-RAY DETERMINATION OF THE ELECTRON DISTRIBUTION IN ALUMINUM. H. Bensch, H. Witte, and E. Wölflel (Technische Hochschule, Darmstadt, Germany). *Z. physik. Chem. (Frankfurt)* [N.F.] **1**, 256-8(1954) May. (In German).

X-ray reflection at room temperature was used to determine the electron distribution in single crystals of Al. By means of a three-dimensional Fourier analysis the distribution of the electron density through the atomic center of gravity was determined as 10.2 electrons/atom, in good agreement with previous measurements. (J.S.R.)

AEROSOLS

7056

Atomic Energy Research Establishment, Harwell, Berks (England)

ASPECTS OF TRAVEL AND DEPOSITION OF AEROSOL AND VAPOUR CLOUDS. A. C. Chamberlain. Sept. 17, 1953. 34p. (AERE-HP/R-1261)

The various ways in which aerosols and vapors are deposited on surfaces are reviewed. Calculations are made of the rate of wash-out in rain. Sutton's equations for the diffusion of clouds from ground level and elevated sources are considered, and it is shown how the equations can be modified to take deposition into account. Values of deposition parameters which give maximum deposition at given distances from ground level sources are obtained. (auth)

7057

Illinois Univ. Engineering Experiment Station
DEPOSITION OF SUSPENDED PARTICLES FROM TURBULENT GAS STREAMS. S. K. Friedlander. Sept. 15, 1954. 48p. Contract AT(11-1)-276, Technical Report No. 13. (COO-1014)

The deposition of suspended particles from turbulent streams was studied by passing suspensions of small particles in air through tubes of varying diameter at different velocities. Particle transfer coefficients were calculated from the deposition rates and concentrations. The rates of deposition were determined by counting under a microscope the particles deposited in a given time on a known area of tube wall. The concentration of the aerosol was measured by passing a known volume through a Millipore filter and counting the particles deposited on the filter. Turbulent deposition was found to be an inertial effect; the rate increased rapidly as the particle diameter and gas velocity increased. The data were correlated by means of an analysis of the von Karman type, assuming that the particles diffused to within one stopping distance of the wall. (auth)

COSMIC RADIATION

7058

DETERMINATION OF THE MASS OF THE CHARGED COSMIC-RAY PARTICLES WITH A LIFE PERIOD OF $2 \mu\text{-SEC}$. A. O. Vaisenberg, G. A. Marikyan, and V. M.

Kharitonov. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, No. 5, 550-61(1953). (In Russian).

Research was carried out to provide answers to the following questions: (1) does the air stream of cosmic rays at an altitude of 3250 m contain, besides the μ mesons, also other unstable particles with the same life period, and (2) what is the nature of the decay of particles to which a mass greater than that of the proton should be ascribed? Masses of particles decaying within $1 \mu\text{sec}$ were determined by using an apparatus which is described and illustrated; all disintegrations observed can be explained by assuming the presence of μ and π mesons. Decays were also observed involving the incidence of the meson-generating protons on the absorbing substance. (Science Abstracts)

7059

ELECTRON DENSITY DISTRIBUTION NEAR LARGE AIR SHOWER AXES AT SEA LEVEL. R. E. Heineman (Univ. of Michigan, Ann Arbor). *Phys. Rev.* **96**, 161-73(1954) Oct. 1.

A large, multiple-wire ionization chamber has been used to sample 20 separate areas of the plane of observation to obtain detailed "profiles" of the structure of large air showers within about 2 meters of their axes. Interpretation of the data is based on (1) quantitative calculations of the transition effect in 0.305 radiation lengths of dural, and (2) a semiquantitative discussion of the fluctuations in the lateral-distribution function. Lateral-distribution functions for electrons and photons of various energies have been calculated for $r < 10$ meters at the shower maximum and the function for electrons of all energies turns out to be essentially equal to the one given by Molière. No drastic revision of the calculated distribution function is indicated by the data, but a flatter distribution than that calculated is not ruled out. Evidence for a multiple-core structure in a small percentage of cases is presented. (auth)

7060

MAGNETIC CLOUD CHAMBER STUDY OF $V \pm$ EVENTS. Y. B. Kim, J. R. Burwell, R. W. Huggett, and R. W. Thompson (Indiana Univ., Bloomington). *Phys. Rev.* **96**, 229-31(1954) Oct. 1.

The distributions of transverse moments for $13 V^+$ and $18 V^-$ cases as observed with a rectangular magnetic cloud chamber are presented. The proposed decay characteristics are compared with the observations of previous investigators. (L.M.T.)

7061

PHYSICAL NATURE OF THE INSTABILITY OF STARS AND THE ORIGIN OF COSMIC RAYS. I. M. Gordon. *Doklady Akad. Nauk S.S.S.R.* **97**, 621-4(1954) Aug. 1. (In Russian).

Evidence is presented to support the hypothesis that cosmic particles are generated by the instability of supernovae and the sun. (J.S.R.)

7062

ON THE THEORY OF THE LATITUDE EFFECT OF THE NUCLEON COMPONENT OF COSMIC RADIATION. Juan G. Roederer (Comisión Nacional de la Energía Atómica, Buenos Aires, Argentina). *Z. Naturforsch.* **9a**, 740-7 (1954) Sept. (In German).

The theory of nucleon cascades with respect to the latitude effect was developed. From the diffusion equations

the expression for the intensity of protons and neutrons was determined for the case of a cutoff primary spectrum; numerical calculations were carried out on the basis of the production spectrum. The absorption of nucleons of different energies, the dependence of the absorption length on the atmospheric depth for different energies, the integral latitude effect for protons and neutrons as a function of energy, and the integral intensity of protons and neutrons as a function of the geomagnetic latitude were shown. A comparison of theory with experimental data was made. (tr-auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE 7063

Laboratory for Insulation Research, Mass. Inst. of Tech. COLOR CENTERS IN CALCIUM FLUORIDE CRYSTALS. A. Smakula. Sept. 1954. 19p. Contracts N5ori-07801 and DA-19-020-ORD-3429, Technical Report No. 86. (NP-5345)

Synthetic calcium fluoride crystals of various quality were colored by 2.5-Mev electrons, calcium vapor, and low-energy electrons. Impurities and imperfections of the crystals were compared by ultraviolet transmission, density, ionic conductivity, and spectroanalysis. The best crystals show good transmission in the near and far ultraviolet, high density, low ionic conductivity, and have a low yield of color centers. Four absorption bands located at 2.16, 3.14, 3.70, and 5.50 eV are observed. The intensity ratio of the bands remains constant up to the highest coloration ($K = 3 \text{ mm}^{-1}$). Less perfect crystals show lower density, higher ionic conductivity, and some absorption in the ultraviolet. The coloration is higher, and the absorption bands vary somewhat in spectral position and intensity. It is concluded that the 4 bands observed in the best crystals are caused by electrons and/or holes trapped in lattice imperfections and not by chemical impurities as has been suggested by Lüty. (auth)

7064

Oak Ridge National Lab.

THE CRYSTAL STRUCTURES OF OXALIC ACID DIHYDRATE AND ALPHA IODIC ACID AS DETERMINED BY NEUTRON DIFFRACTION. B. S. Garrett. Aug. 16, 1954. 149p. Contract W-7405-eng-26. (ORNL-1745)

The crystal structures of oxalic acid dihydrate and alpha iodic acid were determined by neutron diffraction. Techniques are described which were utilized in analyzing the data, including Fourier series, structure factor inequalities, statistical intensity distributions, least squares, and Fourier peak shape analysis. The positions of all the atoms, including hydrogen, were determined. (auth)

7065

LOCATIONS AND SIZES OF INTERSTITIAL HOLES IN THE ALPHA-URANIUM LATTICE. A. J. Opinsky (Sylvania Electric Products, Inc., Bayside, N. Y.). *J. Metals* 6, 913-14(1954) Aug.

The locations and sizes of various interstitial holes in the orthorhombic U lattice based on a hard-sphere model is indicated. Plane configurations of three and four atoms were examined and the true interstices surrounded by four atoms in space and by five atoms in space were obtained. (auth)

ELECTRICAL DISCHARGE

7066

EFFECT OF ELASTIC COLLISIONS BETWEEN ELEC-

TRONS AND MOLECULES ON LONGITUDINAL ELECTRIC WAVES IN THE PLASMA. M. E. Gertsenshtein. *Zhur. Eksptl'. i Teoret. Fiz.* 24, No. 6, 652-8(1953). (In Russian).

The effect of the active energy losses caused by elastic collisions between electrons and molecules on the propagation of the longitudinal waves in the plasma is analyzed. In particular, the wide divergence found between theory and experiment for the depth of penetration of longitudinal waves into the plasma is explained. A simplified form of writing the collision integral in the case of volume charges is given. It is shown that the collision-caused active losses are insignificant if the phase velocity of the longitudinal wave is small. (Science Abstracts)

7067

ENRICHMENT OF ISOTOPIC MOLECULES IN THE DIRECT CURRENT GLOW DISCHARGE. III. THE PRIMARY EFFECT. MASS SPECTROGRAPHIC DETERMINATION OF THE RELATIVE ION FREQUENCY IN THE DISCHARGE PLASMA. H. D. Beckey and H. Dreeskamp (Univ. of Bonn, Germany). *Z. Naturforsch.* 9a, 735-40 (1954) Sept.

The theory of the primary effect of the isotopic enrichment in direct-current glow discharge was tested experimentally in which the relative frequency of the single ion type in a hydrogen discharge was determined by mass spectrographic analysis. The relative frequency of the H_2^+ ion is the same order of magnitude as that of H^+ , whereas that of the H_2^+ ion amounts to only a few percent of the total ion frequency. In 1:1 mixtures of H_2 and D_2 it was found that $1.31 < [\text{D}^+]/[\text{H}^+] < 1.41$ and $1.61 < [\text{D}_2^+]/[\text{H}_2^+] < 1.76$. (tr-auth)

ELECTRONS

7068

ON THE QUANTUM THEORY OF THE MOTION OF RELATIVISTIC ELECTRONS IN AN AXIAL-SYMMETRICAL MAGNETIC FIELD. A. A. Sololov and I. M. Ternov. *Doklady Akad. Nauk S.S.S.R.* 97, 823-6(1954) Aug. 11. (In Russian).

The results on the motion of a relativistic electron in a homogeneous field are generalized for the case of non-homogeneous fields with axial symmetry, when the magnetic field near the stable orbits (i.e., $Z = 0$) changes according to $H_x = H_y = 0$, $H_z = H_0 r^{-q}$, $0 < q < 1$. (J.S.R.)

7069

PROBLEM OF THE TRANSVERSE ENERGY OF THE ELECTRON IN A LINEAR GENERALIZATION OF ELECTRODYNAMICS. V. K. Peterson. *Zhur. Eksptl'. i Teoret. Fiz.* 24, No. 1, 56-64(1953). (In Russian).

The transverse self-energy of the electron is calculated using the Bopp-Podolsky generalization of quantum electrodynamics and Dirac hole theory. It is found to be positive. An error in a previous work, in which a negative self-energy was found, is pointed out.

GASES

7070

SECONDARY ELECTRON EMISSION BY PHOTOELECTRIC ACTION AND ION BOMBARDMENT AT THE CATHODE IN CORONA BREAKDOWN OF ARGON. Laura Colli and Ugo Facchini (Univ. of Calif., Berkeley). *Phys. Rev.* 96, 1-4(1954) Oct. 1.

Differences between the secondary cathode mechanisms active in coaxial cylindrical argon-filled counter tubes

with positive central wire at various gas pressures observed by E. J. Lauer at Berkeley and the authors at Milan have been resolved as a result of recent work by the authors at Berkeley. It appears that at pressures ranging from 1000 to about 150 mm Hg, with spectroscopically pure argon, the dominant mechanism is a photoelectric liberation from the cathode caused by photons with some microseconds of time delay and of energy about 10 ev. These lead to a corona threshold with γ_p ranging from 1 to 5×10^{-2} , uncorrected for electron back diffusion. At pressures between 25 and 100 mm Hg an electron liberation by impact of A^+ and A_2^+ ions on the Ni cathode was confirmed to be important in the corona current in agreement with Lauer's findings. This effect seems to be very dependent on the conditions of the surface and was found to be active only after a degassing at 900°C for hours. (auth)

7071

THE TRANSPORT PROPERTIES AND EQUATION OF STATE OF GASEOUS MIXTURES OF THE HELIUM ISOTOPES. E. G. D. Cohen, M. J. Offerhaus, and J. De Boer (Univ. of Amsterdam, Netherlands). *Physica* 20, 501-15 (1954) Aug. (In English)

On the basis of the 12-6-Lennard-Jones potential field, used in previous publications to describe the properties of the pure gases He^3 and He^4 , a quantum mechanical calculation has been made of the properties of gaseous mixtures of He^3 and He^4 : (1) the self-diffusion coefficient and the mutual diffusion coefficient in the first and second approximation; (2) the viscosity and the heat conductivity of mixtures of He^3 and He^4 ; (3) the thermal diffusion ratio k_T ; and (4) the second virial coefficient of mixtures of He^3 and He^4 . The theoretical data for the viscosity of mixtures of He^3 and He^4 show a satisfactory agreement with recent measurements made by Van Itterbeek et al. and Becker et al. Measurement of the thermal diffusion would be a very sensitive test of the present calculations. (auth)

INSTRUMENTS

7072

Atomic Energy Research Establishment, Harwell, Berks (England)
A SIMPLE CIRCUIT FOR CONTROL OF BATH TEMPERATURE. A. G. White. Apr. 1954. 5p. (AERE-C/M-202)

A simple circuit employing thermistors is described which is capable of controlling the temperature of a small bath to within $\pm 0.02^\circ C$ and which permits very easy adjustment of the temperature to any desired value. (auth)

7073

Cornell Aeronautical Lab., Inc.
PROPOSED FUTURE INVESTIGATIONS OF HIGH TEMPERATURE WIRE RESISTANCE STRAIN GAGES. J. E. Carpenter. Aug. 1953. 27p. (CAL-IG-886-S-1)

A general discussion of the present status of high-temperature wire resistance strain gages is presented. Possible avenues of approach for arriving at an improved, universally accepted high-temperature strain gage are reviewed, and investigations directed toward the early attainment of this goal are recommended. These investigations are concerned with the development of three different strain gages capable of satisfactory operation up to their own respective temperature limits of 600, 1000, and 1500°F. It is pointed out that the key to successful high-temperature instrumentation is the ability to eliminate tem-

perature effects from the strain gage signal, and possible methods of achieving this goal are presented. Of the suggested possibilities, the most promising method is the one which introduces a simple mechanical-electronic circuit to conventional strain gage systems. The basic details of this circuit plus the results of preliminary bench tests are presented. (auth)

7074

Mound Lab.
THERMAL BATTERIES USING POLONIUM-210. (INFORMATION REPORT). K. C. Jordan and J. H. Birden. June 2, 1954. 17p. Contract AT-33-1-GEN-53. (MLM-984)

The general theory of thermal batteries of the thermopile type is developed, and this theory is applied to the design of batteries powered by Po^{210} heat sources. The physical characteristics, performance, and fabrication of two experimental batteries with 57 and 146 curies, respectively, of Po^{210} are described. Maximum electrical power delivered to a load was 0.1 and 0.2 per cent of the power developed as heat by the polonium. The work capacity of the thermal batteries is 1.8 and 9.2 times, respectively, that of a commercial mercury battery (RM4Z), and the weight is 30 per cent less. (auth)

7075

Office of Basic Instrumentation, National Bureau of Standards
STABILITY OF NONLINEAR FEEDBACK CONTROL SYSTEMS. J. Frank Koenig. Aug. 1954. 23p. (NBS-3619)

In the design of automatic control systems increasing attention is being paid to nonlinearities, which may be inherent or may be introduced deliberately. Graphical methods have been devised for predicting the tendency to sustained oscillation. In linear theory, the prediction can alternatively be based on the characteristic equation, using the methods of Routh or Hurwitz. This paper presents a somewhat analogous analytical method, based on a continued-fraction expansion of the coefficients of a complex differential equation, and applicable to certain classes of nonlinear physical systems. (auth)

ISOTOPES

7076

ISOTOPE PRODUCTION: HOW TO CHOOSE IRRADIATION TIME. Wm. Bradley Lewis (Phillips Petroleum Co., Idaho Falls, Idaho). *Nucleonics* 12, No. 10, 30-3 (1954) Oct.

Rigorous analysis of the general rate equations governing isotope production and decay is presented, with usage shown for the cases of Au^{198} , Au^{199} , and Tm^{170} . (auth)

7077

RADIOELEMENTS AND ACCESSORIES FOR INDUSTRY, RESEARCH AND MEDICINE. (Catalog C). Ottawa, Atomic Energy of Canada Ltd., n.d., 163p. gratis.

This catalog contains a list of radioelements and accessories for industry, research, and medicine available from Atomic Energy of Canada Limited. (C.H.)

7078

THE PRODUCTION OF RADIO-ISOTOPES. A. H. W. Aten (Institute for Nuclear Physics, Amsterdam, Netherlands) and J. Halberstadt (Isotope Lab., N. V. Philips Roxane, Amsterdam, Netherlands). *Philips Tech. Rev.* 16, 1-12 (1954) July.

General characteristics of nuclear reactions are reviewed, and methods used for the production of radioisotopes from the Philips synchrocyclotron at Amsterdam are described. (C.H.)

ISOTOPE SEPARATION

7079

THE SEPARATION TUBE. XIII. PURIFICATION OF THE HEAVY CARBON ISOTOPE C^{13} . Klaus Clusius and Hans Heinrich Bühler (Univ. of Zürich, Switzerland). *Z. Naturforsch.* 9a, 775-83(1954) Sept. (In German).

A separation tube unit is described in which heavy methane with an initial C^{13} content from 55 to 70% was split into fractions with 3 to 6% $C^{13}H_4$ and 99 to 99.8% $C^{12}H_4$. A substantial improvement over other procedures consists in the discontinuing of the convection circuit connecting the separation tube units which were replaced by a gas tube. An assay shows a molecular weight of 17.034 corrected for the ideal state, whereas 17.036 is expected for $C^{13}H_4$. $C^{13}H_4$ and $C^{12}H_4$ have, in spite of the mass difference of a unit, only a difference of the triple point pressure of 0.04 mm Hg, whereas $C^{13}H_4D$, which has practically equal mass with $C^{13}H_4$, has a triple point pressure about 3.15 mm smaller. The separation was checked by a survey of the Angström and Swan bands for different C^{13} contents. (tr-auth)

MATHEMATICS

7080

Oak Ridge National Lab.

ON SOLVING LINEAR ALGEBRAIC SYSTEMS. A. S. Householder. Oct. 13, 1954. 20p. Contract W-7405-eng-26. (ORNL-1785)

MEASURING INSTRUMENTS AND TECHNIQUES

7081

Phillips Petroleum Co., Atomic Energy Div.

AVERAGE THERMAL NEUTRON FLUX FROM BISMUTH MONITOR. C. H. Hogg. Oct. 21, 1953. 12p. Contract AT(10-1)-205. (IDO-16128)

A method of determining average thermal neutron flux by measuring the polonium produced in an irradiated bismuth monitor is described. The heat generated by Po^{210} decay is determined with a calorimeter. An equation for calculating the flux is derived. The average flux in an experimental facility found to be $2.3 \times 10^{14} \pm 20\%$ with the bismuth compares favorably with the value 2.2×10^{14} measured with an indium foil technique. (auth)

7082

North American Aviation, Inc.

CORRECTION FACTORS FOR MEASUREMENTS WITH CADMIUM COVERED FOILS. David H. Martin. Oct. 15, 1954. 13p. Contract AT-11-1-GEN-8. (NAA-SR-1076)

Cadmium-covered foils are frequently used to measure the neutron flux with energy above that represented by the cadmium cut-off point. Correction factors to account for the attenuation of the epithermal neutrons by the cadmium are given and compared with results by earlier experimenters. In the present work, foil area, foil thickness, and cadmium ratio were varied with no detectable effect on the correction factor. Values are given for both indium and gold, and a further small correction to account for the leak-through of subcadmium or thermal neutrons is discussed. (auth)

7083

Naval Medical Research Inst., Bethesda

THE CALIBRATION OF GAMMA EMITTING RADIOISOTOPES IN TERMS OF IONIZATION PRODUCED. 1. A TECHNIQUE FOR CONTROLLED SCATTER CONDITIONS. J. W. Duckworth. June 16, 1954. 10p. (NM-006-012.04.71)

The technique of calibrating gamma-emitting radioisotopes by comparison of ionization produced with that of a standard source such as radium is commonly employed. An important source of error in such a technique is found in the inability to account for the effect of scattered radiation. To make possible a correction to zero scatter effect, a technique of controlled scatter conditions has been developed and tested. Alternate measurements of ionization intensity with half or full scatter environment may be made, and the desired scatter correction factor may be calculated by orientating the source and detector symmetrically on the axis of a scatter tube constructed in two longitudinal sections. Corrected intensity versus source to distance values closely approached the inverse square relationship, thus providing a simple test for the validity of such a technique. (auth)

7084

Atomic Energy Project, Univ. of Calif., Los Angeles

A SMALL RADIATION MONITOR TELEMETER WITH TRANSISTOR CIRCUIT ELEMENTS. Frank C. Strebe and William R. Kennedy. Oct. 14, 1954. 13p. Contract AT-04-1-GEN-12. (UCLA-310)

The general problem of using transistors in a small telemetering unit for transmitting radiation data is discussed. A pilot model using both point contact type and junction type transistors is described and illustrated with circuit diagrams and photographs. It is pointed out that additional study should make it possible to reduce the size of the unit still further and to increase the output of the oscillator circuit. (auth)

7085

THE MEASUREMENT OF RADIOACTIVE SAMPLES FOR CLINICAL USE. W. K. Sinclair, N. G. Trott, and E. H. Belcher (Royal Cancer Hospital, London, England). *Brit. J. Radiol.* 27, 565-74(1954) Oct.

The importance of accurate measurements of sample activity in relation to the dosimetry of clinical isotope procedures is discussed. Standards of each isotope or reliable absolute methods of measurement are necessary and must be applied to the routine measurement of sample activity. An account is given of the absolute methods (defined solid angle β counting, 4π scintillation β counting, and γ ionization measurements) used at the Royal Cancer Hospital. The accuracy obtainable and the limitations of each method are described. A number of practical methods for routine sample measurements are described. Ionization chambers have been found particularly suitable for this purpose. It is considered that for most isotopes of medical importance, the activity of samples intended for clinical use can be specified with an accuracy of ± 5 per cent using these techniques. (auth)

7086

RADIATION MONITOR FOR ATOMIC TESTS. National Bureau of Standards. *J. Franklin Inst.* 258, 305-10(1954) Oct.

A remote-control VHF f-m radio link is described for the automatic measurement of radiation intensities in the

vicinity of an atomic explosion which is removed from a centrally located headquarters. (K.S.)

7087

SCINTILLATION SPECTROMETER WITH IMPROVED RESPONSE. P. R. Bell (Oak Ridge National Lab., Tenn.). *Science* 120, 625-6(1954) Oct. 22.

Design modifications are described which provide improved response for a γ -ray scintillation spectrometer. (C.H.)

7088

DEVICE FOR ACCURATE LOCATION OF EVENTS IN NUCLEAR EMULSION. Jay Orear (Univ. of Chicago, Ill.). *Rev. Sci. Instr.* 25, 875-6(1954) Sept.

A scale with 100 μ fine divisions and 1000 μ coarse divisions is pressed into the emulsion by rolling a fine toothed wheel across the emulsion. The position of the fine division on a 10 by 10 rectangular grid reticle (whipple disk) can be recorded to within 1 μ accuracy. This permits quick repositioning of events and strips with 1 μ accuracy independent of the accuracy of the stage motion. (auth)

7089

ARRANGEMENT OF DELAYED COINCIDENCES WITH RESOLVING PERIOD OF 10^{-7} SEC. A. O. Vaisenberg. *Zhur. Eksptl. i Teoret. Fiz.* 24, No. 5, 545-9(1953). (In Russian).

A radiotechnical arrangement of delayed coincidences, suitable for measuring periods in the range from 2×10^{-7} to 10^{-8} sec, is fully described and illustrated. It is one of the variants of the arrangement described by Zhdanov and Naumov, involving the use of the self-extinguishing counters as detectors, which generate the short-period voltage pulses when a meson or disintegration particle passes through them. It has been found that, in counters 80 cm long and 3 cm in diameter, filled with A (8 cm Hg) and methylal (1 cm Hg), a lag of 0.5 to 1 μ sec occurred once in 400, and a lag exceeding 1 μ sec once in 5000 passages. (Science Abstracts)

7090

ON THE EFFICIENCY OF LARGE AREA LIQUID SCINTILLATION COUNTERS FOR COSMIC RAYS. G. H. Vaze (Tata Inst. of Fundamental Research, Bombay, India). *J. Sci. Ind. Research (India)* 13, 527-30(1954) Aug.

A single 1P21 photomultiplier was used to view the scintillations produced in a large-area liquid counter by cosmic rays, and the efficiency data obtained with the instrument are presented. The difficulties and limitations of using a single photomultiplier are discussed. (auth)

7091

MEASUREMENT OF THE SHRINKAGE FACTOR OF NUCLEAR EMULSIONS. M. Gailloud, Ch. Haenny, and R. Weill. *Helv. Phys. Acta* 27, 337-54(1954) Aug. (In French).

Some nuclear emulsions were irradiated by a canalized beam of α particles at a known angle of incidence in order to determine the shrinkage factor. The irradiation was made at $20 \pm 1^\circ\text{C}$ and 56% relative humidity, and the humidification for the observation was made at $25 \pm 1^\circ\text{C}$ and 51% relative humidity. The values found, with an error of less than 2%, are in agreement with previous results. The indices of refraction were measured for emulsions fixed and washed in equilibrium with the atmosphere at different humidities in order to determine the true shrinkage factor. The shrinkage factor remains the same for different angles. (tr-auth)

7092

A TIME-OF-FLIGHT NEUTRON SPECTROMETER. P. E. Trier (Mullard Research Labs., Salfords, England), J. C. Hammeton (Atomic Energy of Canada Ltd.), and E. Wolfendale (Mullard Research Labs., Salfords, England). *Philips Tech. Rev.* 15, 325-40(1954) June.

The design of a time-of-flight neutron spectrometer constructed for use in conjunction with the 15-Mev linear accelerator at Harwell is described. Use of the instrument for measurements of neutron reaction cross sections of elements in the energy region 1 ev to 20 kev is discussed. Block diagrams show the principal units and details of the master timing unit, delay units, delay circuits, and gating units. Photographs of the main assembly and the master timing unit are included. (C.H.)

7093

THE ALPHA GAUGE. E. N. Shaw (Isotope Developments, Ltd., Beenham Grange, Aldermaston Wharf, Berks, England). *J. Brit. Inst. Radio Engrs.* 14, 414-18(1954) Sept.

The apparatus described is for the measurement of weight per unit area of very thin materials, such as capacitor paper. An alpha source is used in conjunction with an ionization chamber backed off by a similar system. The algebraic sum of the currents is fed into a stable d-c amplifier, and the out-of-balance reading calibrated in terms of weight. The sources of error are investigated, together with methods of compensation. Results obtained under factory conditions are also discussed. (auth)

7094

A GAMMA RAY THICKNESS GAUGE FOR HOT STEEL STRIPS AND TUBES. G. Syke (Baldwin Instrument Co., Ltd., Dartford, Kent, England). *J. Brit. Inst. Radio Engrs.* 14, 419-26(1954) Sept.

A prototype gamma-ray thickness gauge for hot mills rolling steel strip of 0.05 to 0.30 in. thickness is described, which uses a scintillation detector and provides distinct readings at short time intervals. Each reading represents the mean thickness of the strips during the preceding interval. The result is displayed on a lamp board and gives a visual picture of the longitudinal profile of each strip. Automatic standardization when no strip is passing through the measuring head is incorporated. Results obtained and performance of the instrument are presented and discussed. An adaptation of the above instrument for gauging the wall thickness of hot steel tubes is described. (auth)

7095

A COMBINED BETA AND DIELECTRIC GAUGE. R. Y. Parry (Ekco Electronics Ltd., Southend-on-Sea, Essex, England). *J. Brit. Inst. Radio Engrs.* 14, 427-32(1954) Sept.

Beta gauges are now being used in many industries and are noteworthy for their long term stability, however, they do not have a fast response time. Dielectric gauges, on the other hand, have a fast response time, do not possess an adequate long term stability. Therefore, by combining the two gauges in a single installation, an equipment is obtained which has long term stability and high speed response. (auth)

7096

TRENDS IN NUCLEAR INSTRUMENTATION. Denis Taylor (Atomic Energy Research Establishment, Harwell, Berks England). *Nucleonics* 12, No. 10, 12-19(1954) Oct.

Modifications and improvements in design are reported

for portable radiation-monitoring apparatus, scaling circuits, pulse amplifiers, photomultipliers, scintillators, instruments for radiochemical instrumentation, circuit techniques, transistor circuits, and instruments for reactor instrumentation. (C.H.)

7027

FILM BADGE DOSIMETRY: HOW MUCH FADING OCCURS? William L. McLaughlin and Margarete Ehrlich (National Bureau of Standards, Washington, D. C.). Nucleonics 12, No. 10, 34-6(1954) Oct.

Latent-image fading, sometimes large, varies widely with emulsion type. Grave errors in radiation dose vs. film density readings can result unless adequate corrections are applied. Semi-empirical equations relating fading to storage are presented. (auth)

7008

NUCLEAR EMULSION INSTABILITY. J. S. Cheka (Oak Ridge National Lab., Tenn.). Nucleonics 12, No. 10, 58(1954) Oct.

The problem of latent image instability in nuclear emulsions is discussed, and the necessity for calibrating each batch of film is emphasized. (C.H.)

7009

COBALT-60 UNIT FOR CHECKING THIMBLE CHAMBERS. E. Dale Trout, John P. Kelley, and Arthur C. Lucas (General Electric Co., Milwaukee, Wis.). Nucleonics 12, No. 10, 58(1954) Oct.

The design of a simple unit utilizing 14 mc of Co^{60} constructed for periodically checking thimble chambers used with a Victoreen r-meter is described. (auth)

7100

SIMPLE EFFICIENT SHIELD FOR WELL-TYPE SCINTILLATION CRYSTALS. John W. Irvine, Jr. (Massachusetts Inst. of Tech., Cambridge). Nucleonics 12, No. 10, 62-3 (1954) Oct.

The shield described was designed to reduce the background of well-type NaI(Tl) crystals in scintillation counters used for tracer experiments involving γ or high-energy β emitters. (C.H.)

MESONS

7101

A DETERMINATION OF μ -MESOTRON REST LIFETIME AND A VERIFICATION OF THE RELATIVISTIC EXPRESSION FOR VARIATION OF LIFETIME WITH MOMENTUM. D. W. Seymour and W. F. G. Swann (Bartol Research Foundation, Swarthmore, Penna.). J. Franklin Inst. 258, 277-86(1954) Oct.

Measurements of cosmic ray intensity have been made simultaneously with counter telescopes at altitudes differing by about 3000 ft and in locations which were the same within a distance of about 8 miles. Data were obtained for various thicknesses of lead absorber and with an additional thickness of absorbing material in the upper telescopes to compensate for absorption in the air column between the two sets of telescopes. From the foregoing data the rest mean life values have been calculated on the basis of the relativistic variation of mean life with momentum for various ranges of momenta of the rays concerned. The theory of the calculation allows for the continual change of mean life resulting from loss of momentum of the mesotrons as they pass through the air. The value of the rest mean life obtained is 2.3×10^{-6} sec and is constant over the ranges of momenta concerned,

within the limits of accuracy of the data, thus confirming to this extent the relativistic expression. The results are in close agreement with those of Rossi et al, but differ from the results obtained by Nielsen. (auth)

7102

THE ANOMALOUS SCATTERING OF μ -MESONS. G. D. Rochester and A. W. Wolfendale (Manchester Univ., England). Phil. Mag. (7) 45, 980-5(1954) Sept.

A re-examination of the data on the scattering of fast μ mesons in the photographic emulsion has been made for a number of nuclear models. It is shown that the most reasonable models still predict less scattering than is observed. However, because of the absence of an exact model of the nucleus and exact scattering calculations for μ mesons, it is not possible to conclude that the anomaly indicates the existence of a nonelectric, short-range interaction between the μ meson and the nucleon. (auth)

7103

REVISED SYMBOLS FOR THE NEW UNSTABLE PARTICLES. R. W. Thompson (Indiana Univ., Bloomington). Science 120, 585-7(1954) Oct. 15.

7104

PRODUCTION OF CHARGED PIONS FROM HYDROGEN AND CARBON. A. H. Rosenfeld (Univ. of Chicago, Ill.). Phys. Rev. 96, 130-9(1954) Apr. 1.

The cross sections and energy spectra of pions produced in the reactions $P + P \rightarrow \pi^+ + D$ and $P + P \rightarrow \pi^+ + N + P$ have been measured at three angles using 440-Mev protons. Both reactions contribute about equally to the total cross section. The total cross section is (4 ± 1) mb and the angular distribution is proportional to $(0.15 \pm 0.06 + \cos^2\theta)$. The energy spectra of π^+ and π^- produced in a carbon target at 90° in the laboratory system was measured. Values found were $(d\sigma_{\pi^+}/d\Omega) = (0.83 \pm 0.11)$ mb sterad $^{-1}$ per C nucleus and a π^+/π^- ratio of 7.2 ± 1.5 . (auth)

7105

PRODUCTION OF PIONS IN NUCLEON-NUCLEON COLLISIONS AT CYCLOTRON ENERGIES. A. H. Rosenfeld (Univ. of Chicago, Ill.). Phys. Rev. 96, 139-49(1954) Oct. 1.

All available data on the production of pions in nucleon-nucleon collisions at cyclotron energies are compiled and are compared with the phenomenological theory of Watson and Brueckner. The principle of conservation of isotopic spin allows all these cross sections to be written in terms of only three independent cross sections, whose excitation functions are predicted by the phenomenological model. The theory represents satisfactorily the excitation functions and the angular distributions that are known experimentally; however the experimental ratio $\sigma(P + P \rightarrow \pi^+ + N + P)/\sigma(P + P \rightarrow \pi^+ + D)$ appears to be about a factor 2 larger than predicted. Using a notation for total cross section in which the first subscript indicates the isotopic spin of the initial state, and the second that of the final state of the two nucleons, and expressing all cross sections in millibarns, it is found: $\sigma_{10}(D) = \sigma(P + P \rightarrow \pi^+ + D) = 0.14\eta + 1.0\eta^3$, $\sigma_{10}(N + P) = \sigma(P + P \rightarrow \pi^+ + N + P) - \sigma_{11} \approx 1.5\eta^4$, $\sigma_{01} = 2\sigma(N + P \rightarrow \pi^0) - \sigma_{11} \approx 0.3\eta^4$, $\sigma_{11} = (P + P \rightarrow \pi^0) \approx 0.2\eta^8$. η is the maximum c.m. momentum available to the pion, measured in units of μc . (auth)

7106

K MESONS AND A CHARGED HYPERON PRODUCED BY 3-BEV PROTONS IN EMULSIONS. W. F. Fry and M. S. Swami (Univ. of Wisconsin, Madison). Phys. Rev. 96, 235-7(1954) Oct. 1.

Three events interpreted as two K mesons and a hyperon were found in 4.5 cc of emulsion after exposure to a reduced proton flux in the Cosmotron. The mass of the K_1 particle was found to be $850 \pm 150 m_e$, and the event seems consistent with a decay into a μ meson and a single neutrino or into an electron and two neutrinos. A mass of $920 \pm 200 m_e$ was found, but no decay scheme is proposed because the decay track dipped too steeply in the emulsion. The hyperon event is interpreted as $Y^+ \rightarrow P + \pi^+ + Q$, the Q value being about 117 ± 2 Mev. (L.M.T.)

METEOROLOGY

7107

Brookhaven National Lab.

APPLICABILITY AND KEY TO METEOROLOGICAL

PUNCH CARD DATA, APRIL 1950-MARCH 1952. M. E. Smith and I. A. Singer. Mar. 1954. 14p. Contracts [AT-30-2-GEN-16] and AF19(604)-490. (BNL-288)

A description is presented of all information contained in punch cards covering Brookhaven micrometeorological data obtained from readings of instruments operated continuously over a two-year period. The position and meaning of each entry is defined. (C.H.)

7108

Pennsylvania State Univ. Mineral Industries Experiment Station

STATISTICAL PROPERTIES OF THE VERTICAL FLUX AND KINETIC ENERGY AT 100 METERS. FINAL REPORT.

Isaac Van der Hoven and H. A. Panofsky. June 30, 1954. 111p. Contract AF19(604)-166. (NP-5347)

This report describes the spectral distributions of turbulent energy and stress at 23, 46, and 91 m, as well as the relations between energy and stress with mean wind speed, radiation, lapse rate and height. The following tentative conclusions can be drawn: (1) The importance of low frequencies in spectra and cross spectra of all kinds increases with increasing height and with decreasing stability. (2) Spectral intensities are generally linear functions of the square of the wind speed. (3) The ratio of cross spectrum to spectrum of vertical velocity at any frequency is well determined by the ratio of vertical wind shear and frequency. As long as this second ratio is less than 2, the relation is linear. As a result, high frequencies contribute relatively more to the energy than the stress. (4) Spectra of horizontal wind speed decrease much more rapidly with increasing wind speed than do the spectra of vertical wind speed. Over most of the observed frequency range, the spectra of horizontal wind speed decrease by a power greater in absolute value than -2 . As a result, high frequency energies of horizontal and vertical motions are of the same order of magnitude, whereas at low frequencies, horizontal energies generally predominate. The greater the stability, the greater the predominance of horizontal energy. (5) At least under stable conditions at 91 m, and under all conditions at lower levels, a gap in the horizontal speed spectra is indicated at frequencies less than 20 cycles/hour. There is little difference between the spectra of horizontal speed and those of the wind component in the mean wind direction. (6) Quadrature spectra make possible an estimate of the vertical extent of the predominant eddies. (7) The stress and energy of turbulence near 100 m, both vertical and three-dimensional, can be estimated from the wind speed at a given level and short-wave radiation intensity. (8) Eddy viscosities at 100 m depend strongly on the stability of the

air, but apparently not on the wind speed. They increase with height from 23 to 91 m, the rate of increase being greatest in the most unstable air. (9) Stress and energy decrease with increasing height when the stratification is near-neutral. However, there is a tendency for the energy to reach a maximum somewhere between 23 and 91 m under unstable conditions. (auth)

NEUTRONS

7109

Atomic Energy Research Establishment, Harwell, Berks (England)

MILNE'S PROBLEM WITH CAPTURE. J. B. Sykes. May 1954. 17p. (AERE-T/M-110)

The variational solution given by Le Caine for Milne's problem with neutron capture is developed as a power series as far as the first power of the parameter $\alpha = l_{\text{tot}}/l_c$. This solution is then transformed to give the solution for a semi-infinite medium with a normal incident current, using the analysis of Placzek and Davison. The application of such solutions to obtain an accurate analysis of observational data for water is discussed. (auth)

NUCLEAR PHYSICS

7110

Rochester Univ.

LECTURES ON STRONG COUPLING MESON THEORY

(GIVEN AT THE UNIVERSITY OF ROCHESTER, SPRING, 1954). Gregor Wentzel—B. P. Nigam and A. E. Woodruff, comps. Sept. 7, 1954. 82p. Contract AT(30-1)-875. (NYO-6235)

7111

Radiation Lab., Univ. of Calif., Berkeley

PHYSICS DIVISION QUARTERLY REPORT [FOR] MAY, JUNE, JULY 1954. Sept. 8, 1954. 52p. Contract W-7405-eng-48. (UCRL-2691)

Values of the fraction of surface nucleons that are neutrons were obtained for 6 nuclei by bombardment with 300-Mev neutrons. Fast deuterons were produced by a pickup process where the energy dependence of the process is given most accurately by $P = 0.12E^{-2.5}$. For heavy elements, the data show a nuclear skin that is predominantly neutrons. The differential cross sections for photodisintegration of the deuteron by high-energy γ rays was measured at angles of 49, 75, 106, and 141° (lab). No great variation of cross section with energy is evident. The angular distribution is peaked forward, dropping from 6 mb/sterad at 49° to about 2 mb/sterad at 141°. Cross sections of the $p + p \rightarrow \pi^+ + d$ reaction were measured near threshold, in the energy range 310 to 339 Mev. Recent development and operation of the Bevatron is discussed. (For preceding period see UCRL-2630.) (K.S.)

7112

RATIO OF $\bar{\Gamma}_n^0/\bar{D}$ FOR SLOW NEUTRON RESONANCES. R. S. Carter, J. A. Harvey, D. J. Hughes, and V. E. Pilcher (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **96**, 113-14(1954) Oct. 1.

A survey has been made of resonance parameters of the heavy elements which have been measured recently. The variation of the ratio $\bar{\Gamma}_n^0/\bar{D}$ with atomic weight has been compared with theoretical predictions. A maximum was found in the ratio $\bar{\Gamma}_n^0/\bar{D}$ at atomic weight of approximately 160 in fair agreement with the more recent theories of

neutron scattering by nuclei. The experimental data, however, are not sufficiently accurate to make a choice between the new theories which have been proposed. (auth)

7113

NOMOGRAM FOR NUCLEAR REACTION CALCULATIONS. F. J. M. Farley (Auckland Univ. Coll., New Zealand). *Nucleonics* 12, No. 10, 56-7(1954) Oct.

A nomogram is presented which may be used to relate the particle energy, direction, and intensity in the laboratory frame of reference to the corresponding quantities in the center-of-mass frame of reference in the analysis of nuclear reactions. (C.H.)

NUCLEAR PROPERTIES

7114

Oak Ridge National Lab.

COULOMB EXCITATION OF NUCLEAR LEVELS. L. C. Biedenharn and M. E. Rose. Oct. 14, 1954. 16p. Contract W-7405-eng-26. (ORNL-1789)

A theoretical development for the Coulomb excitation process of nuclear levels is presented. Difficulties encountered with previous classical formulations have been avoided by the use of a quantum mechanical perturbation treatment. The consideration of quadrupole transitions leads to an approach which is best described in spherical coordinates for solutions of the total cross section and angular distribution problems. The reduction of such a representation to the evaluation of radial integrals involves the use of computers. (K.S.)

7115

IDENTIFICATION OF PLATINUM-188. Robert A. Naumann (Princeton Univ., N. J.). *Phys. Rev.* 96, 90-2(1954) Oct. 1.

An unstable even-even neutron-deficient platinum isotope with a half-life of 10.3 ± 0.4 days has been prepared and assigned a mass number 188. The decay of this isotope results in unstable iridium 188, which in turn decays to a known excited state in stable osmium 188. (auth)

7116

INDIRECT EXCHANGE COUPLING OF NUCLEAR MAGNETIC MOMENTS BY CONDUCTION ELECTRONS. M. A. Ruderman and C. Kittel (Univ. of California, Berkeley). *Phys. Rev.* 96, 99-102(1954) Oct. 1.

A calculation is given of the indirect exchange $I_i \cdot I_j$ type coupling of nuclear magnetic moments in a metal by means of the hyperfine interaction with the conduction electrons. The interaction appears to account qualitatively for the broad nuclear spin resonance lines observed in natural metallic silver. It is expected that the interaction may sharpen the resonances in pure isotopic specimens. The line shape of the minority isotope in a binary mixture may tend to be Gaussian, while that of the majority isotope may tend to be Lorentzian, if the indirect exchange interaction is dominant. (auth)

7117

TOTAL CROSS SECTIONS OF LIQUEFIED GASES FOR HIGH-ENERGY NEUTRONS. Peter Hillman, R. H. Stahl, and N. F. Ramsey (Harvard Univ., Cambridge, Mass.). *Phys. Rev.* 96, 115-20(1954) Oct. 1.

Total neutron cross sections of liquid H, He, N, O, A, and several solid elements have been measured at effective energies of 88 ± 2 and 47.5 ± 2 Mev. A liquid scintillation neutron counter was used. Results are in good agreement with previous experiments, where applicable. (auth)

7118

NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF Na^{23} . S. Sengupta (Government Coll., Darjeeling, West Bengal, India). *Phys. Rev.* 96, 235(1954) Oct. 1.

Calculations for both the magnetic and quadrupole moments of Na^{23} were carried out, using the $(d_{3/2} s_{1/2})_{3/2}$ configuration with jj coupling. Results give $\mu = 1.78$ nm, and $Q = + (8/35) \langle r^2 \rangle_{av} = + 0.041 \times 10^{-24} \text{ cm}^2$, where $\langle r^2 \rangle_{av}$ is calculated from the formula $r = 1.5 \text{ A}^{1/2} \times 10^{-13} \text{ cm}$. (L.M.T.)

7119

ENERGY LEVELS OF Np^{237*} . John Milsted, Salomon Rosenblum, and Manuel Valadares. *Compt. rend.* 239, 700-2(1954) Sept. 20. (In French)

The energy level scheme of Np^{237*} is given, together with the nature and polarity of the associated γ radiations. The precision of the γ measurements is sufficient to show that the energies vary according to the corrected theory of Bohr-Mottelson. (tr-auth)

7120

HIGH FREQUENCY TRANSITIONS IN THE $7P_{3/2}$ TERM OF THE Cs ATOM AND DETERMINATION OF THE QUADRUPOLE MOMENT OF THE Cs^{133} NUCLEUS. Karl-Heinz Althoff and Hubert Krüger (Univ. of Heidelberg, Germany). *Naturwissenschaften* 41, 368-9(1954). Aug. (In German).

Three transitions corresponding to the selection rule $F = 1$ were observed in a high-frequency field, and the measurements are tabulated. The quadrupole moment was determined as $Q(\text{Cs}^{133}) = -0.003 \pm 0.002 \times 10^{-24} \text{ cm}^2$.

(J.S.R.)

7121

ON THE HIGHLY EXCITED STATES OF LIGHT NUCLEI. A. Florian and P. Urban (Univ. of Graz, Austria) and K. Wildermuth (Univ. of Munich, Germany). *Z. Naturforsch.* 9a, 748-57(1954) Sept. (In German).

For the ground state and an excited state of O^{16} as well as for the ground state of N^{16} simple approximation functions were formulated. The Ritz variation method (parameter $a = -Mv/\hbar$) gives the approximate energy eigenvalue and the term diffusion. The deviations from the experimental results are discussed, and the conclusions for the two-body force are derived. (tr-auth)

7122

THE EVEN MASS ISOMERS IN LEAD. D. Maeder, A. H. Wapstra, G. J. Nijgh, and L. Th. M. Ornstein (Instituut voor kernfysisch onderzoek, Amsterdam, Netherlands). *Physica* 20, 521-38(1954) Aug. (In English)

1.1 hr Pb^{204*} has been measured with scintillation and β spectrometers. The isomeric transition has an energy of $913 \pm 2 \text{ kev}$ ($K/(L + M) = 1.32 \pm 0.07$, $\alpha_K = 0.056 \pm 0.003$) and is considered to be of the E5 type; it is followed by a $374.5 \pm 1 \text{ kev}$ transition ($\alpha_K = 0.04 \pm 0.015$, $K/(L + M) = 1.76 \pm 0.1$, $L/(M + N) = 3.5 \pm 1$). A $3.5 \pm 0.1 \text{ hr}$ isomer, discovered in these experiments, is ascribed to Pb^{202*} ; it decays partly by a $128 \pm 1 \text{ kev}$ E4 transition followed by a $658.2 \pm 1.3 \text{ kev}$ E1 γ ray, partly by a $788.5 \pm 1 \text{ kev}$ E5 γ ray; both modes of decay are followed by $421.4 \pm 0.5 \text{ kev}$ and $963 \pm 1.5 \text{ kev}$ E2 γ rays. Other conversion lines need further investigation to give them a consistent interpretation. The level schemes of Pb^{202} , Pb^{204} , and Pb^{208} are discussed on the basis of configurations with two excited neutrons. In an appendix graphs of the relation between K/L and Z^2/E are presented. (auth)

7123

COULOMB EXCITATION OF ISOMERIC STATES IN SILVER. Torben Huus and Arnold Lundén (Univ. of Copenhagen, Denmark). *Phil. Mag.* (7) 45, 966-72(1954) Sept.

The time delay in the decay of Coulomb-excited nuclei can be used to improve background conditions so that weaker excitations can be detected. As an example the excitation of the 40-second isomeric activity in silver has been investigated. The measured yield curve shows that the excitation takes place mainly via a higher-lying rotational state. A brief discussion of the rotational spectrum and the decay scheme is given. (auth)

7124

NUCLEAR SPIN OF ^{241}Pu . B. Bleaney, P. M. Llewellyn, and M. H. L. Pryce (Clarendon Lab., Oxford, England) and G. R. Hall (Atomic Energy Research Establishment, Harwell, Berks, England). *Phil. Mag.* (7) 45, 991-2(1954) Sept.

The paramagnetic resonance spectrum has been analyzed of a single crystal of $(\text{UO}_2)_2\text{Rb}(\text{NO}_3)_3$ containing about 40 micrograms of Pu^{241} . Using a wavelength of 3.3 cm and temperatures of 10 to 20°K, six equally spaced lines were observed due to the ^{241}Pu isotope, showing that the nuclear spin is $5/2$. The separation between successive lines was 245 ± 1 gauss, while separation between the two hyperfine lines due to the isotope ^{239}Pu (observed in the same crystal) was 347 ± 1 gauss. Since the nuclear spin of the latter isotope is $1/2$, the ratio of the nuclear magnetic moments is $\mu(^{241}\text{Pu})/\mu(^{239}\text{Pu}) = 3.53 \pm 0.02$. (auth)

7125

SHORT RANGE FORCES AND NUCLEAR ENERGY LEVELS IN THE NEIGHBOURHOOD OF ^{208}Pb . D. M. Brink (Clarendon Lab., Oxford, England). *Proc. Phys. Soc. (London)* A76, 757-72(1954) Sept. 1.

The lowest excited states of nuclei differing by two particles from the double closed shell of Pb^{208} , can be classified in terms of two-particle configurations. For a two-particle configuration, this paper gives an expansion for the matrix elements of a short-range central-interaction potential of any exchange type, as a power series in the range of the potential. It is shown that, in any configuration and with forces of range consistent with low energy proton neutron scattering data, the zero range approximation for the matrix elements is good for Wigner or Bartlett forces. For Majorana and Heisenberg forces the zero range approximation is fair for states of highest spin, but is inadequate for the states of lowest spin. Calculations applied to Bi^{210} indicate that the β decaying state of this nucleus has spin 0, 1 or possibly 2 and odd parity. (auth)

NUCLEAR REACTORS

7126

[Atomic Energy Research Establishment, Harwell, Berks (England)]

THE CRITICAL SIZE OF A SPHERICAL PILE USING A TWO GROUP THEORY. J. F. Hill. [1949?] 5p. (AERE-T/M-21)

An explicit formula for the critical radius of a spherical reacting medium which is surrounded by an effectively infinite reflector is given using a two-group theory. (auth)

7127

Argonne National Lab.

REACTOR ENGINEERING LECTURES. Stuart McLain.

Sept. 1954. 74p. Contract W-31-109-eng-38. (ANL-5311(pt.1))

Notes from the 9 unclassified lectures of the total of 34 which were presented in a reactor engineering course at ANL from September 1953 to June 1954 are included; notes of the remaining 25 classified lectures are bound as Parts 2 and 3 of the same report. The information included here may be considered somewhat as introductory, and as in the entire series, attempt is made to present the principles involved in the subjects rather than covering all the related facts. However, a considerable number of tables and formulas are given when needed. Topics covered are reactor design (criteria and procedures), fluid flow (dimensional analysis, pressure drop, hydrodynamic aspects, cavitation, and gas cooling), heat transfer (by conduction, by radiation, and from fluid flow), and reactor materials (selection, toxicity, radioactivity, and properties). (L.M.T.)

7128

Joint Establishment for Nuclear Energy Research (Norway) MEASUREMENTS OF FAST NEUTRON FLUX IN THE CENTRE OF JEEP. Bertel Grimeland. July 1954. 10p. (JENER-28)

In many cases (n,p) or (n,α) reactions induced by fast neutrons lead to radioactive nuclei. Cross sections for such reactions are given by Hughes. By using some of his values it was possible to measure the fast neutron flux. The absolute β activity was measured with a plastic scintillator and a photomultiplier tube. The flux of fast neutrons at the center of JEEP (channels 5 to 11) was found to be $(2.3 \pm 0.3) \times 10^5$ neutrons/cm²/sec/watt. The experiments indicate that the cross section for the reaction $\text{S}^{32}(n,p)\text{P}^{32}$ is about 45 barns instead of 30 as given by Hughes. (auth)

7129

HOW TO TEST A NUCLEAR POWER PLANT. *Nucleonics* 12, No. 10, 22-5(1954) Oct.

A contract will be let about Jan. 1, 1955, for the Army Package Power Reactor (APPR), the first reactor to be built on a lump-sum basis. Strict specs have been set by AEC and Army. Details of reactor test requirements and features of the contract to be negotiated are presented. (auth)

7130

CRITICALITY OF NORMAL-WATER NATURAL-URANIUM LATTICES. Rolf Persson (AB Atomenergi, Stockholm, Sweden). *Nucleonics* 12, No. 10, 26-9(1954) Oct.

Multiplication constant of a hexagonal lattice of 3.0-cm uranium rods in ordinary water was determined as a function of rod spacing. A differential method and an integrating method were used. Maximum value of k_{∞} was 0.970 ± 0.015 when rods were spaced 4.5 cm. (auth)

7131

KINETICS OF CIRCULATING REACTORS AT LOW POWER. Joseph A. Fleck, Jr. (Brookhaven National Lab., Upton, N. Y.). *Nucleonics* 12, No. 10, 52-5(1954) Oct.

Effect of delayed neutrons on the kinetic behavior of circulating-fuel reactors at low power is not predicted by simplified circulation-parameter theory. Instead, reactor periods can be calculated by finding eigenvalues of a system of differential equations, which are presented. (auth)

7132

IS THIS THE FIRST REACTOR DESIGN? *Nucleonics* 12, No. 10, 64-5(1954) Oct.

A patent application is discussed which includes a descrip-

tion of the functions, importance, and relationships of fuel, moderator, coolant, and control elements for a power reactor. The National Center for Scientific Research, Paris, France, applied for the Swiss patent on April 19, 1940. It was granted June 30, 1944, with a priority to May 1, 1939. (C.H.)

7133

DETERMINING NUCLEAR FUEL REQUIREMENTS FOR LARGE-SCALE INDUSTRIAL POWER. James A. Lane (Oak Ridge National Lab., Tenn.). *Nucleonics* **12**, No. 10, 65-7(1954) Oct.

Nuclear fuel requirements for large-scale industrial power reactors are compared for breeder and converter reactors. (C.H.)

NUCLEAR TRANSFORMATION

7134

Harvard Univ.

NUCLEAR REACTIONS OF 100 MEV PROTONS WITH COBALT. PART 1. EXPERIMENTAL TECHNIQUES.

Rodman A. Sharp. [1954] 117p. Contract AT(30-1)-1461. (NYO-6384)

7135

ABSOLUTE CROSS SECTION VERSUS ENERGY OF THE $\text{Cu}^{63}(\gamma, n)$ AND $\text{Cu}^{63}(\gamma, 2n)$ REACTIONS. Arthur L. Berman and Karl L. Brown (Stanford Univ., Calif.). *Phys. Rev.* **96**, 83-9(1954) Oct. 1.

Experimental values were found for the absolute cross section of both $\text{Cu}^{63}(\gamma, n)$ and $(\gamma, 2n)$ reactions versus quantum energy from threshold to 36 Mev. Statistical and systematic errors were limited by the use of (a) the direct electron beam of the Stanford 36-Mev linear accelerator, which produced bremsstrahlung immediately before and within the copper foils under bombardment, (b) an electron-beam collector which recorded the total accumulated charge in the incident flux, (c) a 4π scintillation counter which measured the activity of the resultant Cu^{62} and Cu^{61} , and (d) electroplated foils of separated Cu^{63} isotope. The cross-section curves of the two reactions are similar—both rise rapidly to a maximum value about 6 Mev above threshold and then fall to zero almost as rapidly. The integrated cross sections were found to be 0.55 ± 0.03 and 0.081 Mev-barn for the (γ, n) and $(\gamma, 2n)$ reactions, respectively. The $(\gamma, 2n)$ threshold is 20.0 ± 0.5 Mev. A precision of 0.5 percent was attained in the relative (γ, n) activation points and 5 percent in the absolute cross section integrated over energy. The corresponding errors in the $(\gamma, 2n)$ data were 5 and 20 percent; the latter value includes the effect of a 10 percent uncertainty in the currently published data on the electron-capture to positron-emission ratio of Cu^{61} . (auth)

7136

ANGULAR DISTRIBUTION OF PROTONS EMITTED IN THE REACTION ${}^7\text{N}^{14}(\alpha, p){}_8\text{O}^{17}$. G. S. Mani and R. Pandhi (Tata Inst. of Fundamental Research, Bombay, India). *Proc. Indian Acad. Sci.* **40A**, 61-6(1954) Aug.

Using a conventional six-inch Wilson chamber with a special collimating system for the alpha particles, 353 useful proton tracks emitted in the reaction ${}^7\text{N}^{14}(\alpha, p){}_8\text{O}^{17}$ have been obtained in a total of 8,000 pictures. The source of alpha particles was a 10 mc polonium source electrolytically deposited on a 2×2 mm platinum foil. The collimating system consisted of a rectangular brass frame with two parallel thin gold foils soldered to its sides. The thickness of the gold foil was enough to stop the alpha

particles but allow the protons from the ${}^7\text{N}^{14}(\alpha, p){}_8\text{O}^{17}$ reaction to enter the sensitive volume of the chamber. The source was kept at one end of the frame and the alpha particles were allowed to enter into the region between the gold foils through a small hole 1.5 mm in diameter. The advantages of such a system are: (1) the source is isolated from the sensitive volume of the chamber and as such prevents the spread of the alpha contamination into the chamber, (2) throughout the range of the alpha beam the lateral spread is restricted to 2 mm, (3) only 0.2 mm of the alpha range is lost in the process of collimation, (4) the amount of target gas required is small, as it needs to be introduced only into the small region between the gold foils. The only difficulty of the method is that the thin gold foils occasionally get punctured and introduce gas motion inside the chamber. The tracks were photographed by two cameras whose axes were inclined to each other at 30° , one of the cameras being mounted normal to the plane of the chamber. (auth)

7137

EXCITED STATES IN Be^{10} AND Be^8 . T. W. Bonner and C. F. Cook (Rice Inst., Houston, Texas). *Phys. Rev.* **96**, 122-5(1954) Oct. 1.

A new technique for detecting neutron thresholds by using a slow neutron counter and a conventional long counter is described. By means of this technique, neutron thresholds from the deuteron bombardment of Li^7 have been studied at energies from 0.4 Mev to 4.7 Mev. Thresholds were observed at energies of 1.34, 2.18, 3.37, 3.6, and 4.07 Mev. These thresholds indicate excitation levels in Be^8 at 16.06, 16.72, 17.65, 17.8, and 18.19 Mev. By the same method, excited states of B^{10} from the $\text{Be}^9(d, n)\text{B}^{10}$ reaction were found at 4.78, 5.11, 5.17, 5.93, 6.06, 6.16, 6.43, and 6.57 Mev. (auth)

7138

SPECTROMETER STUDIES OF THE RADIATIONS OF SOME NEUTRON-DEFICIENT ISOTOPES OF XENON AND IODINE. Hirdaya B. Mathur and Earl K. Hyde (Univ. of California, Berkeley). *Phys. Rev.* **96**, 126-9(1954) Oct. 1.

Neutron-deficient isotopes of xenon have been produced by (p, xn) reactions with high-energy protons on potassium iodide targets. The xenon activities were deposited on foils by the glow discharge technique and their radioactive properties were measured. Nineteen-hour Xe^{122} decays by electron capture to 3.5-minute I^{122} . Gamma rays of 182 and 235 kev accompany this decay. I^{122} decays by emission of 3.12-Mev positrons. Xe^{123} decays with a 1.8-hour half-life into 13-hour I^{123} . Positrons of 1.7 ± 0.1 Mev, 150-kev gamma rays, and x-rays are associated with this decay. Xe^{121} has a half-life of 40 ± 10 minutes for decay into 1.6-hour I^{121} . (auth)

7139

REACTIONS OF CESIUM WITH PROTONS AT 60, 80, 100, 150, AND 240 MEV. Richard W. Fink and Edwin O. Wiig (Univ. of Rochester, N. Y.). *Phys. Rev.* **96**, 185-7(1954) Oct. 1.

Absolute production cross sections have been determined for certain isotopes of barium, cesium, iodine, and tellurium produced by reactions of cesium with protons of energies 60, 80, 100, 150, and 240 Mev. The yields are based on the known cross section for the monitor reaction $\text{Al}^{27}(p, 3pn)\text{Na}^{24}$. In the region up to 100 Mev the data indicate that the yields are largely explained on the basis of an evaporation mechanism which competes with the

prompt knock-on optical model to an extent which decreases rapidly with increasing energy because of increasing nuclear transparency. The neutron pick-up reaction manifests itself in extraordinarily large yields of Cs^{132} and to a lesser extent in the yields of Cs^{131} . Formation of small amounts of neutron-excess iodine isotopes argues for alpha-particle fragmentation especially at the lower bombardment energies. (auth)

7140

EXCITATION FUNCTION OF THE $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$ REACTION IN THE BEV REGION. R. L. Wolfgang and G. Friedlander (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **96**, 190-1(1954) Oct. 1.

The ratio of the cross section of the $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$ reaction to the cross section of the $\text{Al}^{27}(\text{p}, 3\text{pn})\text{Na}^{24}$ reaction has been measured in the energy range 400 Mev to 3 Bev. This ratio as well as the excitation curve of the $\text{C}^{12}(\text{p}, \text{pn})\text{C}^{11}$ reaction appear to be quite insensitive functions of the energy in the range studied. A possible interpretation is discussed. (auth)

7141

GAMMA RADIATION FROM THE REACTIONS $\text{Na}^{23} + \text{p}$. J. O. Newton (Atomic Energy Research Establishment, Harwell, Berks, England). *Phys. Rev.* **96**, 241-2(1954) Oct. 1.

Gamma rays from the three reactions $\text{Na}^{23}(\text{p}, \text{p}'\gamma)\text{Na}^{23}$, $\text{Na}^{23}(\text{p}, \alpha\gamma)\text{Ne}^{20}$, and $\text{Na}^{23}(\text{p}, \gamma)\text{Ne}^{20}$ were studied by means of NaI scintillation detectors over the proton bombarding range 0.7 to 1.5 Mev. The energies of the γ 's from the inelastic scattering and the $(\text{p}, \alpha\gamma)$ reactions were found to be 444 ± 5 kev and $1,629 \pm 0.008$ Mev, respectively, in agreement with other work. The observed capture γ 's can be related to transitions to the ground state of Mg^{24} , to and from the well-known levels at 1.37 and 4.12 Mev, and to and from the level recently reported at 4.24 Mev. In addition, a γ ray of energy 3.86 ± 0.04 Mev in coincidence with γ 's of 1.37 and 7.9 Mev was definitely observed at one resonance and less definitely at another. A possible interpretation is that it arises from a triple cascade transition through a level at 5.23 ± 0.04 Mev, since such a level could be reached in the β decay of Na^{24} . A proposed energy level scheme for Mg^{24} is presented, with the observed γ 's shown. (L.M.T.)

7142

THE NEUTRONS AND ALPHA-PARTICLES FROM THE DISINTEGRATION OF ^9Be BY 6 MEV GAMMA-RAYS. J. H. Carver, E. Kondalah, and B. D. McDaniel (Australian National Univ., Canberra). *Phil. Mag.* (7) **45**, 948-56(1954) Sept.

By measuring the total photoneutron yield, the cross section for neutron production from Be^9 under irradiation with the $\text{F}^{19}(\text{p}, \alpha, \gamma)$ radiation is found to be $\sigma_t = (12.5 \pm 1.2) \times 10^{-28}$ cm². The energy spectrum of the two alpha particles, which are emitted in coincidence in the breakup, has also been studied; the cross section for all beryllium photoprocesses which lead to the emission of two alpha particles, both of whose energies exceeds 400 kev, is found to be $\sigma_\alpha = (12.8 \pm 2.5) \times 10^{-28}$ cm². The near equality of σ_t and σ_α shows that the disintegration rarely proceeds through the Be^9 ground state, while a detailed examination of the coincident alpha-particle spectrum suggests that (γ, n) and (γ, α) reactions are present. The (γ, n) transitions are mainly through the 2.9-Mev excited state of Be^8 and the (γ, α) transitions mainly through the He^5 ground state, the branching ratio being roughly 1.2:1. (auth)

7143

THE PHOTO-PRODUCTION OF AN ISOMERIC STATE IN ^{207}Pb . J. M. Reid and K. G. McNeill (Glasgow Univ., Scotland). *Phil. Mag.* (7) **45**, 957-65(1954) Sept.

The 0.8-second activity produced in Pb by irradiation in the x-ray beam of a 23-Mev synchrotron was shown to arise from a disintegration of Pb^{208} by comparing the effects produced in a target of natural Pb and a similar target of Pb enriched in the 208 isotope. The γ rays emitted by the short-lived activity were investigated with a scintillation spectrometer. The resulting spectrum and the half life of the activity agree with the known spectrum and half life associated with the $i_{1/2}$ isomeric state in Pb^{207} . The reaction was thus determined to be $\text{Pb}^{208}(\gamma, \text{n})\text{Pb}^{207*}$. An estimate of the threshold for the production of the isomer was made by comparing, at different settings of the maximum x-ray energy from the machine the intensity of the isomeric activity and the activity produced in Ag. The value thus obtained was 9.0 ± 0.1 Mev. The threshold calculated from the ground state mass differences, the energy of the isomeric level, and the centrifugal barrier corresponding to the orbital angular momentum of the emitted neutron is shown to be significantly greater than 9.0 Mev. It is suggested that the isomeric state is reached, not directly, but through a level of spin $3/2$ lying slightly above the isomeric level. (auth)

7144

ANGULAR DISTRIBUTIONS OF PROTONS FROM $\text{Na}^{23}(\text{d}, \text{p})\text{Na}^{24}$ AND $\text{Ti}^{47,48}(\text{d}, \text{p})\text{Ti}^{46,49}$. M. M. Bretscher, J. O. Alderman, A. Flwyn, and F. B. Shull (Washington Univ., St. Louis, Mo.). *Phys. Rev.* **96**, 103-9(1954) Oct. 1.

Sodium and titanium targets were bombarded with 10-Mev deuterons, and angular distributions of protons from the stripping reaction were observed with arrays of nuclear emulsions. Absorbing foils in front of each emulsion were arranged so that the integrated flux of protons in a limited energy range could be determined. Distributions were found for each of the four most energetic proton groups from sodium, corresponding to Q values of 4.731 (ground state), 4.259, 4.167, and 3.390 Mev. The data were compared with the Butler theory, and l_n values of 2, 2, 0, and 0, respectively, were necessary to fit theory to data. With Ti^{47} targets, l_n values of 3, 1 (and 3?), 1, and 1, respectively, were determined for proton groups corresponding to Q values of 8.14, 6.81, 5.83, and 4.83 Mev. With Ti^{48} targets, l_n values of 3, 1, 1, and either 1 or 2 were determined for proton groups corresponding to Q values of 5.81 (ground state), 4.46, 4.11, and 3.40 Mev, respectively. From these data, parity and possible spin values for the various states of Na^{24} , Ti^{48} , and Ti^{49} are deduced. (auth)

7145

DIFFERENT OXIDATION STATES OF MANGANESE PRODUCED BY THE $\text{Fe}(\text{n}, \text{p})\text{Mn}$ REACTION. C. Lakshman Rao, Hari D. Sharma, and Jagdish Shankar (Atomic Energy Commission, Bombay, India). *Proc. Indian Acad. Sci.* **40A**, 102-5(1954) Aug.

The presence of Mn^{54} in neutron-irradiated Fe^{54} is confirmed. Chemical means were employed to determine that the Mn^{54} is present in the manganous and permanganate states, but principally as MnO_2 . Mechanisms leading to the presence of these oxidation states are discussed. (K.S.)

7146

GAMMA RADIATION FROM THE REACTION $^{11}\text{B}(\text{p}, \gamma)^{12}\text{C}$.

P. J. Grant, F. C. Flack, J. G. Rutherglen, and W. M. Deuchars (Glasgow Univ., Scotland). Proc. Phys. Soc. (London) A67, 751-6(1954) Sept. 1.

The angular distributions of the 16.1, 11.7, and 4.4-Mev γ rays from the reaction $B^{11}(p, \gamma)C^{12}$ have been determined at a number of bombarding energies. The angular distribution of the 16-Mev radiation is shown to be consistent with the accepted assignment of $J = 2^+$ to the resonance at $E_p = 163$ kev, and shows interference involving a higher level having $J = 1^-$ which is identified with the broad resonance at $E_p = 1390$ kev. The angular distribution of the 11.7 Mev radiation shows interference between the resonances at 680 and 1390 kev and suggests the assignment $J = 2^+$ to the 680-kev resonance. (auth)

7147

THE YIELD CURVE OF THE ${}^7\text{Li}(p, \gamma){}^8\text{Be}$ REACTION. P. C. Price (Cavendish Lab., Cambridge, England). Proc. Phys. Soc. (London) A76, 849-51(1954) Sept. 1.

The γ yield curve from proton capture in the $\text{Li}^7(p, \gamma)\text{Be}^8$ reaction, using protons of energy 0.5 to 2.5 Mev, was measured at the 441-kev resonance using a scintillation detector. A resonance of 150-kev half-width occurs at about 1 Mev, and a broad resonance or group of resonances was observed near 2 Mev. (K.S.)

PARTICLE ACCELERATORS

7148

Atomic Energy Research Establishment, Harwell, Berks (England)

GRIDS FOR A PROTON LINEAR ACCELERATOR. L. B. Mullett and J. R. Day. Mar. 1953. 5p. (AERE-GP/M-149)

Grids of the type used in the Alvarez 32 Mev Berkeley linear accelerator can be seen geometrically to stop about 1.5 to 1.7% of the proton beam. If some allowance is made for the tungsten ribbon not being absolutely edge-on to the beam then the figure of 2% quoted by Alvarez seems a reasonable one. For a 450 Mev machine extrapolated from Alvarez and using a grid on every other gap, the mean power dissipation per grid can be computed for the desired mean current output of 1 microamp. The highest power dissipated in a grid is such that cooling by radiation is very important. The resulting calculations for obtaining the temperature rise involve quite tedious numerical work, even for the mean case in which it is assumed that the pulses are sufficiently short and the repetition rate sufficiently high for the temperature at the end of a pulse to be very little above the average. For a duty cycle of 0.5% and a pulse length of about 200 microseconds these answers should not be greatly in error. (auth)

7149

Atomic Energy Research Establishment, Harwell, Berks (England)

NOTE ON PRE-BUNCHER FOR PROTON LINEAR ACCELERATOR. W. Walkinshaw and M. Ross. Aug. 1952. 10p. (AERE-T/M-66)

The relationship between the bunching voltage, drift space, accelerator peak voltage, and stable phase angle in the beam focusing of a proton linear accelerator is examined. It is concluded that if the drift space is limited to short lengths, then effective phase bunching can only be achieved by large voltage modulation, and the depth of the well is then insufficient to trap the particles. (C.H.)

7150

Atomic Energy Research Establishment, Harwell, Berks (England)

PROTON DYNAMICS IN THE LINEAR ACCELERATOR. 1. GRID-FOCUSSED SECTION. N. M. King. Apr. 1954. 12p. (AERE-T/M-107)

By assuming a simple form for the fields in the accelerator, equations of motion for the phase and radial oscillations of the protons are derived, susceptible to a gap-by-gap computation. The various approximations involved in the treatment are discussed. The results of the orbit computations have been interpreted so as to lead to displacement-divergence phase diagrams representing the types of beams capable of being focused in the accelerator, and the resulting beams at 10 Mev have been determined. The results indicate that, due to large radial excursions of nonsynchronous protons, the actual range of particles trapped in phase will be more curtailed than was suggested by previous considerations. (auth)

7151

European Council for Nuclear Research

LINAC FOCUSING BY MEANS OF A PULSED AXIAL MAGNETIC FIELD. Aug. 1954. 17p. (CERN-PS/HGH-2)

This method of focusing appears to be possible for a 50-Mev linac of the Alvarez type at the low duty cycles required for a synchrotron injector and to have some advantages over other methods. More detailed study is indicated. It is more difficult to apply to a helix structure, and in the appendix it is shown that it is less interesting for the duty cycles around 1% used by the Berkeley linac and the proposed AERE machine. (auth)

7152

Purdue Research Foundation

BASIC RESEARCH WITH HIGH ENERGY ELECTRONS AND X-RAYS PRODUCED BY A 300 MEV SYNCHROTRON. PROGRESS REPORT. June 30, 1954. 46p. Contract AT(11-1)-123. (COO-176)

During the year 1953-54 the 300-Mev Purdue Univ. electron synchrotron has been used for research with high-energy photons. The beam intensity has been sufficient for accurate work with scintillation counter telescopes, a Wilson cloud chamber, and nuclear emulsion plates. Research has been done with all these methods, mainly on high-energy protons from (γ, p) reactions on various elements and on low-energy charged mesons. Some progress has been made toward obtaining more d-c power to get a higher pulse rate and toward a higher voltage injection system. (For preceding period see COO-175.) (auth)

7153

THEORY OF ELECTRON BEAM LOADING IN LINEAR ACCELERATORS. G. Saxon (Metropolitan-Vickers Electrical Co., Ltd., Manchester, England). Proc. Phys. Soc. (London) B67, 705-16(1954) Sept. 1.

An analysis is made of the waveguide circuit of a linear accelerator of electrons employing radio-frequency power feedback to show how the power flowing into such an accelerator varies with the beam loading. The power relationships developed may be used in conjunction with formulae for the energy gain and beam power output of a length of accelerator waveguide to calculate the performance to be expected under feedback conditions as the beam current is varied. If a bunching section forms part of an accelerator, it will have different characteristics from the

rest of the accelerator and the analysis must be modified to take this into account. This applies particularly under the variable power input conditions occurring when feedback is used. Measurements made on two linear accelerators of the variation of energy with beam current have been compared with the theoretically expected performance figures, and a reasonable agreement has been found. (auth)

RADIATION ABSORPTION AND SCATTERING

7154

Nevis Cyclotron Labs., Columbia Univ.

THE ELASTIC SCATTERING OF PIONS ON ALUMINUM. Aihud Pevsner. June 1954. 123p. Contract N6-ori-110, Task No. 1. (NEVIS-3; CU-67-54-ONR-110-1-Phys.)

An analysis of the difference in the elastic scattering of 60-Mev positive and negative pions is presented, using a modified optical model, taking into account the interference of Coulomb and nuclear potentials in a Born approximation. Extensive comparison of the experimental results on Al is made with theory. (K.S.)

7155

Naval Research Lab.

ENERGY FLUX DISTRIBUTIONS NEAR CYLINDRICAL SOURCES. J. D. Plawchan, L. A. Beach, and W. R. Faust. Mar. 10, 1954. 8p. (NRL-4330)

An experimental investigation of the energy flux distributions as observed by Geiger-Mueller counters in the vicinity of thick cylindrical sources of Co^{60} was carried out. A semiempirical expression for the counting rate due to such a homogeneous source was derived and compared with the data. (auth)

7156

Bartol Research Foundation, Franklin Inst.

PROGRESS REPORT FOR THE PERIOD JANUARY 1, 1954-SEPTEMBER 1, 1954. Oct. 1, 1954. 30p. Contract AT(30-1)-1679. (NYO-6456)

Using the ONR-Bartol Van de Graaff generator, neutrons were inelastically scattered from Ba^{137} and Hg^{199} . The cross section for the production of the long-lived metastable state of either element is a function of the energy of the incident neutrons on the interval of neutron energies extending from zero to 3 Mev. Neutrons of energy 3.7 Mev were scattered from Zr, and 14 Mev neutrons were scattered from Fe. The angular distribution of the elastically scattered neutrons was observed in both cases. (auth)

7157

Radiation Lab., Univ. of Calif., Berkeley

PROTON-PROTON SCATTERING EXPERIMENTS AT 170 AND 260 MEV (thesis). John D. Garrison. July 26, 1954. 62p. Contract W-7405-eng-48. (UCRL-2659)

The differential proton-proton scattering cross section has been measured at 170 and 260 Mev for laboratory angles of 4.4° to 30° . The proton beam was obtained by reducing the energy of the 345-Mev beam of the Berkeley cyclotron. A liquid-hydrogen target was used. Counting was done using a telescope of two liquid scintillation counters. A Faraday cup served as a standard for beam calibration. The results indicate a cross section, in the center-of-mass system, independent of energy and rather independent of angle, outside of the Coulomb region. The level of the differential cross section is close to 3.6 millibarns per steradian. (auth)

7158

Radiation Lab., Univ. of Calif., Berkeley

SMALL-ANGLE NEUTRON-PROTON SCATTERING AT 90 AND 290 MEV (thesis). James Warren Easley. Sept. 14, 1954. 47p. Contract W-7405-eng-48. (UCRL-2693)

The relative differential neutron-proton scattering cross section has been measured in the range of center-of-mass angles from 5.1 to 36.0° for approximately 90-Mev neutrons and from 10.7 to 37.8° for approximately 290-Mev neutrons. The scattered neutrons were detected at small angles to the beam. Absolute values of the cross section have been obtained by normalization to prior results. The data indicate an angular distribution for 90-Mev neutrons that is symmetric about 90° in the center-of-mass system but an asymmetric distribution for 290-Mev neutrons, for which $d\sigma_{10^\circ}/d\sigma_{170^\circ}$ equals approximately 0.7. (auth)

7159

EQUATION OF THE ABSORPTION CURVE OF THE RADIATION AT THE ACTIVE LAYER OF SAMPLES FOR S^{35} . A. Z. Kulishenko. Zhur. Fiz. Khim. 28, 1186-92 (1954) July. (In Russian).

The absorption of the β radiation of S^{35} by various materials can be given by the equation $I_x/I_0 = 1 - e^{-0.23x}$. This curve gives an error of 0.4 to 2% in all parts of the curve. (J.S.R.)

7160

RADIATION OF ORIENTED NUCLEI. J. A. M. Cox and S. R. de Groot. Ned. Tijdschr. Natuurk. 20, 189-200 (1954) Aug. (In Dutch).

7161

THE ELASTIC SCATTERING OF PROTONS FROM O^{16} BETWEEN 3 AND 7 MEV. M. Sempert, H. Schneider, and M. Martin (ETH, Zurich, Switzerland). Helv. Phys. Acta 27, 313-36 (1954) Aug. (In German).

The elastically scattered protons from O^{16} have been measured as a function of the incident proton energy at nine different scattering angles between 30 and 150° . The measurements give information about the excited states of the compound nucleus F^{17} . Using graphical methods, the experimental results were analyzed by means of scattering theory. In the case of the following levels spin and parity are given: 4.5 Mev ($\frac{3}{2}^-$), 4.6 Mev ($\frac{3}{2}^+$), 5.15 Mev ($\frac{1}{2}^+$), and 6.65 Mev ($\frac{1}{2}^+$). These four resonances have a level width of several hundred Kev. Between excitation energies of 5 and 7 Mev were also found eight sharp resonances with level widths $\Gamma < 25$ Kev. The experimental widths are compared with theoretical values derived from the model of single particle excitation. The ratio $\Gamma_{\text{exp.}}/\Gamma_{\text{theor.}}$ shows a rapid decrease at 5 Mev, indicating the increasing probability of multiple particle or core excitation at higher energies. (auth)

7162

LARGE ANGLE SCATTERING OF μ -MESONS IN LEAD. I. B. McDiarmid (Manchester Univ., England). Phil. Mag. (7) 45, 933-47 (1954) Sept.

A multiplate cloud chamber operated underground, has been used to investigate the scattering of μ mesons in lead over a wide range of meson energies. The large-angle tails of the measured distributions have been compared with those expected from Molière's theory for a point nucleus and Olbert's modification of this theory for a solid nucleus. At energies of a few hundred Mev the method used is not capable of distinguishing between these two theories, but at higher energies the measured distributions fall very

near to those expected from Molière's theory. No explanation of these departures from the expected distributions for a solid nucleus is offered, but they are in agreement with those found by other workers. It is pointed out that such departures may be due to deficiencies in the theory and do not necessarily indicate a non-Coulomb interaction between fast μ mesons and nucleons. (auth)

7163

ELASTIC SCATTERING OF DEUTERONS BY He^3 . R. J. S. Brown, K. F. Famularo, H. D. Holmgren, D. Rankin, and T. F. Stratton (Univ. of Minnesota, Minneapolis). *Phys. Rev.* **96**, 80-2(1954) Oct. 1.

Differential cross sections for the elastic scattering of deuterons by He^3 have been measured at laboratory energies of 1.02, 1.50, 2.00, 2.50, 3.00, and 3.25 Mev for nine center-of-mass angles ranging from 45° to 125° . At each deuteron energy the cross section passes through a minimum in the vicinity of 90° , with the minimum shifting to slightly higher angles as the bombarding energy increases. The cross section decreases with increasing energy for each angle investigated. At 3.25 Mev the cross section passes through a minimum of 16 millibarns at 100° and rises to approximately 80 millibarns at 45° and 125° . A comparison of the results for the scattering of deuterons by He^3 and by the mirror nucleus H^3 shows the cross sections to be approximately the same except at the lowest energies and forward angles. (auth)

7164

MULTIPLE SCATTERING OF NEUTRONS. George H. Vineyard (Univ. of Missouri, Columbia, and Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **96**, 93-8(1954) Oct. 1.

The theory of multiple scattering of neutrons is developed in cases of interest for diffraction experiments. Computations of second-order scattering for various plane slab sample arrangements are carried out, under a quasi-isotropic cross-section assumption. The relevance of recent computations by Chandrasekhar is pointed out, and these are also applied to the present problem. (auth)

7165

INELASTIC SCATTERING OF 500-MEV NEGATIVE PIONS IN EMULSION NUCLEI. M. Blau (Brookhaven National Lab., Upton, N. Y.) and Martin Caulton (Rensselaer Polytechnic Inst., Troy, N. Y.). *Phys. Rev.* **96**, 150-60(1954) Oct. 1.

Inelastic scattering of 500-Mev negative pions has been investigated in 1700 meson-induced events in emulsion nuclei. Large energy losses and strong angular relationships of the emitted mesons have been observed, similar to those in experiments with lower energy mesons. The possible causes for this behavior are discussed. In 1-3 percent of the events, production of charged mesons has been found. The cross section for meson production on free nucleons is estimated to be between 3.5 and 10 mb, considering the possible absorption of one or both mesons. The angular and energy distributions of mesons and recoiling nucleons in events with meson production are discussed. Six events of π^0 production on free protons (or edge nucleons) have been found. The results compared with observations on meson scattering and meson production in cosmic-ray experiments. (auth)

7166

ELASTIC SCATTERING OF 26-MEV NEGATIVE PIONS BY HYDROGEN IN EMULSION. Jay Orear, and William

Slater (Univ. of Chicago, Ill.) and J. J. Lord, S. L. Eilenberg, and A. B. Weaver (Univ. of Washington, Seattle). *Phys. Rev.* **96**, 174-6(1954) Oct. 1.

Standard Ilford G5 plates were exposed to a fairly monoenergetic 30-Mev π^- -meson beam obtained by slowing down the Chicago 90-Mev beam with absorber and then using magnetic analysis. Range curves were taken indicating a 35 percent contamination from muons and electrons in this geometry. This figure was independently determined from the grain density distribution of tracks in the emulsion. A flux of 2.2×10^5 tracks per cm^2 was used for area scanning. The average beam energy in the plates is (26 ± 2) Mev as determined from measuring the recoil proton energies in the 5 pion-proton scatterings which were found. An equivalent pion path length of 13×10^4 cm was scanned giving a cross section of (1.15 ± 0.6) mb for the 5 events. This cross section is for scatterings greater than 50° . Smaller angle scatterings were not considered because of the possibility that such short recoil protons might be missed by area scanning. Various scanning efficiency checks indicate a scanning efficiency above 90 percent. The data are analyzed to give $(4.7^\circ \pm 2.7^\circ)$ for the phase shift combination $(2\alpha_1 + \alpha_3)$. (auth)

7167

LOW-ENERGY BEHAVIOR OF THE PHASE SHIFTS IN PION-PROTON SCATTERING. Jay Orear (Univ. of Chicago, Ill.). *Phys. Rev.* **96**, 176-9(1954) Oct. 1.

A best fit has been made to all pion-proton scattering phase-shift information under 80 Mev assuming the energy dependence of the phase shifts is momentum to the power $(2l + 1)$ which would be the case for strong short-range interactions. The values obtained for the Fermi-type solutions are $\alpha_{33} = 0.235\eta^3$, $\alpha_3 = -0.11\eta$, and $\alpha_1 = 0.16\eta$. These phase shifts, along with Coulomb forces, fit all scattering experiment data quite closely including the 5-Mev cloud chamber results at Columbia. However, at zero energy they predict $(\alpha_1 - \alpha_3) = 0.27\eta$, while recent photoproduction results and the Panofsky effect as evaluated here predict $(\alpha_1 - \alpha_3) = 0.21\eta$ with rather large uncertainties. (auth)

7168

RELATIVISTIC COULOMB SCATTERING OF ELECTRONS AND POSITRONS. G. Parzen and T. Wainwright (Univ. of Notre Dame, Ind.). *Phys. Rev.* **96**, 188-9(1954) Oct. 1.

The numerical tables of Feshbach for the relativistic Coulomb scattering of electrons and positrons by a nucleus of charge Z have been fitted with an analytic function. The accuracy of the analytic function is equivalent to that of the tables. (auth)

7169

RESULTS OF A PHASE SHIFT CALCULATION OF HIGH-ENERGY ELECTRON SCATTERING. D. G. Ravenhall and D. R. Yennie (Stanford Univ., Calif.). *Phys. Rev.* **96**, 239-40(1954) Oct. 1.

Using the phase shift analysis described previously by Yennie et al. (*Phys. Rev.* **95**, 500(1954)), an attempt has been made to fit the experimental data of Hofstadter et al. (*Phys. Rev.* **95**, 512(1954)) on the elastic scattering of electrons on gold at energies of 84, 126, 154 and 183 Mev. (auth)

7170

APPROXIMATE NUCLEAR DENSITY DISTRIBUTIONS IN LIGHT ELEMENTS. K. M. Gatha, G. Z. Shah, and N. J. Patel (M. G. Science Inst., Ahmedabad, India). *Proc. Phys. Soc. (London)* **A76**, 773-9(1954) Sept. 1.

With a suitable transformation of parameters, it is found that the experimental angular distributions for the nuclear scattering of 340-Mev nucleons by light elements can be reasonably represented by a characteristic angular distribution. Within the region of validity of the first Born approximation, the radial distribution method has been used to determine the corresponding characteristic nuclear density distribution for light elements. (auth)

7171

INELASTIC HEAVY PARTICLE COLLISIONS INVOLVING THE CROSSING OF POTENTIAL ENERGY CURVES. 1. CHARGE TRANSFER FROM H ATOMS TO Be^{2+} , Si^{2+} , AND Mg^{2+} IONS. D. R. Bates and B. L. Moiseiwitsch (Queen's Univ. of Belfast, Ireland). *Proc. Phys. Soc. (London)* **A76**, 805-12(1954) Sept. 1.

$\text{H} + \text{Be}^{2+} \rightarrow \text{H}^+ + \text{Be}^+$, $\text{H} + \text{Si}^{2+} \rightarrow \text{H}^+ + \text{Si}^+$ and $\text{H} + \text{Mg}^{2+} \rightarrow \text{H}^+ + \text{Mg}^+$ are investigated using the Landau-Zener formula for the transition probability arising from the pseudo-crossing of the potential energy curves of the initial and final systems. These pseudo-crossings occur at inter-nuclear distances of 5.8₁, 9.6₄ and 18.9₂ atomic units respectively (allowance being made for the effect of polarizability). It is found that the corresponding values of the energy separation due to the interaction between the initial and final states and 8.6₀ $\times 10^{-1}$, 1.0₂ $\times 10^{-1}$ and 2.3₄ $\times 10^{-5}$ ev. The cross sections associated with the three processes are calculated over a wide range of impact energies. (auth)

7172

COULOMB EFFECTS IN STRIPPING REACTIONS. J. Yoccoz (Univ. of Liverpool, England). *Proc. Phys. Soc. (London)* **A76**, 813-20(1954) Sept. 1.

The coulomb effect in (d, p) and (d, n) stripping reactions at low energies is investigated. It is shown that the angular distribution is flattened, the absolute cross section is decreased, and that the coulomb field contributes to the polarization of the spins of the particles. The calculations are valid for light nuclei only. (auth)

7173

ELECTRON ENERGY DISTRIBUTIONS PRODUCED BY GAMMA-RAYS. H. E. Johns, J. E. Till, and D. V. Cormack (Univ. of Saskatchewan, Saskatoon, Canada). *Nucleonics* **12**, No. 10, 40-6(1954) Oct.

Tables that enable one to calculate the distribution of secondary-electron energies in gamma-ray irradiated materials are presented. Applications to cavity measurements of ionization and to radiological problems are discussed. (auth)

RADIATION EFFECTS

7174

Rock Island Arsenal Lab.

EVALUATION OF RUBBER FOR ORDNANCE USE. REPORT NO. 5. HIGH ENERGY RADIATION OF POLYMERS. A LITERATURE REVIEW. Stanley L. Eisler. Nov. 5, 1953. 16p. (RIA-53-4519; AD-24914)

Information obtained from the survey showed that cross-linkage may be produced in various polymers by their exposure to high-energy radiation. Cross-linking is also possible in a variety of elastomers by means of irradiation with high-energy electrons. Neutron irradiation of rubber vulcanizates is advantageous for natural rubber but degrading for polyisobutylene. The bad effect of irradiation decreases for halogenated polymers, aliphatic polymers,

and aromatic polymers in that order. Irradiation improves the resistance of polyethylene to heat and solvents and indicates that the heat and oil resistance of rubber may be improved by exposure to radiation. A program of study is recommended for improving the oil and heat resistance and aging characteristics of various rubber formulations now under consideration. (ASTIA)

7175

SECONDARY ELECTRON YIELD FROM Al BY HIGH-ENERGY PRIMARY ELECTRONS. G. W. Tautfest and H. R. Fechter (Stanford Univ., Calif.). *Phys. Rev.* **96**, 35(1954) Oct. 1.

The yield of secondary electrons from thin (1.71 mg/cm²) aluminum foils by high-energy primary electrons is reported. The value is 0.0397 ± 0.0003 secondary electron per primary electron from both sides of the foil. The result is independent of the primary-electron energy in the range 111 to 235 Mev. (auth)

7176

RESPONSE OF ACTIVATED BORAZOLE TO RADIATION. J. I. Hoover and C. F. Dohne (Naval Research Lab., Washington, D. C.). *Rev. Sci. Instr.* **25**, 922-3(1954) Sept.

The application of borazole as a liquid scintillator for the detection of neutrons up to 5 Mev was tested by a measurement of the pulse-height spectra from neutron and γ -ray irradiations. The borazole was activated with phenanthrene and carbazole. The scintillation efficiency was relatively poor for protons and heavy particles as compared with electrons. (K.S)

7177

THE EMISSION OF LIGHT IN THE PASSAGE OF ALPHA PARTICLES THROUGH GASES. A. Ward (Glasgow Univ., Scotland). *Proc. Phys. Soc. (London)* **A76**, 841-6(1954) Sept. 1.

The emission of light from the tracks of α -particles in the gases argon, helium, nitrogen and methane has been studied using a photomultiplier. The specific emission along the track has been measured together with the total number of photons which are produced in the range 3000-6000Å. The total number of emitted photons is found to be independent of pressure in the monatomic gases argon and helium, but varies with pressure in nitrogen and in mixtures of methane with argon or helium. The variation with pressure is explained by a simple theory of quenching by collision. The lifetime of the excited states responsible for the emission is estimated to be less than 10^{-6} second. The recombination of the ions is shown to play no appreciable part in the production of the photons. (auth)

RADIOACTIVITY

7178

DECAY SCHEME OF I^{132} . H. L. Finston and W. Bernstein (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **96**, 71-4(1954) Oct. 1.

The radiations of 2.33-hr I^{132} have been investigated with magnetic lens and scintillation spectrometers. Beta rays of 2.12 (18%), 1.53 (24%), 1.16 (23%), and 0.9 (20%) Mev have been identified. Gamma rays of 0.528 (25%), 0.624 (6%), 0.673 (100%), 0.777 (75%), 0.96 (20%), 1.16 (8%), 1.40 (11%), 1.96 (5%), and 2.2 (2%) Mev have been observed, and their coincidences are tabulated. A possible decay scheme is proposed which is consistent with the experimental data. (auth)

7179

TWO-STEP CASCADES IN CHLORINE-36 AND CADMIUM-114 NEUTRON-CAPTURE GAMMA-RAY SPECTRA.

Arthur L. Recksiedler and Bernard Hamermesh (Argonne National Lab., Lemont, Ill.). *Phys. Rev.* **96**, 109-12(1954) Oct. 1.

Two NaI(Tl) crystals were used in conjunction with a twenty- and a single-channel pulse-height analyzer and a 5-microsecond coincidence circuit to determine cascade branches in the neutron-capture gamma-ray emission from Cl^{36} and Cd^{114} . Several two-step cascades in Cl^{36} and one in Cd^{114} have been verified by the present methods. (auth)

7180

ALPHA-EMITTING ISOMER POLONIUM 211. W. Jentschke, A. C. Juveland, and G. H. Kinsey (Univ. of Illinois, Urbana). *Phys. Rev.* **96**, 231-2(1954) Oct. 1.

Spless (*Phys. Rev.* **94**, 1292(1954)) bombarded Pb^{208} with α particles and observed two short-lived α emitters belonging to Po^{211} , α_1 of 7.14 Mev and $T_{1/2} = 25$ sec, and α_2 of 7.43 Mev and $T_{1/2} = 0.52$ sec. He concluded that these are isomeric states of Po^{211} , the 25-sec state being the ground state and the 0.52-sec state being an excited state having a low spin and excitation energy of 0.3 Mev. This explanation leads to a difficulty since in the K-capture decay $\text{At}^{211} \rightarrow \text{Po}^{211}$ only the 0.52-sec activity is observed. Spless also observed long-range α particles but did not identify them. In this note the authors report an investigation of these long-range α particles, and from the results propose a revised decay scheme. The 0.52-sec state appears as the ground state thus eliminating the difficulty mentioned by Spless. The 7.4-Mev α decay does not take place from the ground state of Po^{211} but occurs from a 1.30-Mev 25-sec level and goes to the $1\frac{1}{2}$ state of Pb^{207} . (L.M.T.)

7181

EXPERIMENTAL VERIFICATION OF THE THEORY OF MIGDAL. CASE OF POLONIUM (Po^{210}). Alphonse Lagasse and Jacqueline Doyen. *Compt. rend.* **239**, 670-2 (1954) Sept. 13. (In French).

Electron and γ radiations from Po^{210} are found to agree with a theory due to Migdal (*J. Exp. Theoret. Phys. (USSR)* **11**, 207(1941)). (tr-auth)

7182

NUCLEAR LEVELS IN ^{60}Ni FROM THE DECAY OF ^{60}Cu . R. H. Nussbaum, R. van Lieshout, A. H. Wapstra, N. F. Verster, F. E. L. Ten Haaf, G. J. Nijgh, and L. Th. M. Ornstein (Instituut voor kernfysisch onderzoek, Amsterdam, Netherlands). *Physica* **20**, 555-70(1954) Aug. (In English)

Radiations from Cu^{60} have been investigated by means of a single channel NaI scintillation spectrometer and a magnetic lens type β -ray spectrometer. Moreover, γ - γ coincidences using two single-channel scintillation spectrometers have been measured. Three positron groups and eight γ rays were found. A decay scheme is proposed in which probable spin and parity assignments are given to four new levels in Ni^{60} at 2.18 ± 0.02 , 3.11 ± 0.03 , 3.52 ± 0.05 , and 3.98 ± 0.04 Mev. From the decay characteristics a spin 2^+ could be assigned unambiguously to the Cu^{60} ground state. The total mass difference of 6.23 ± 0.02 Mev between Cu^{60} and Ni^{60} fits well into a linear plot of mass differences of Cu-Ni and Cu-Zn isobars as a function of the mass number A. A discussion of some extrapolations from those plots to yet uncertain

decay characteristics of nuclides in this region is added. A description of the components of the scintillation spectrometer and the two-fold coincidence circuit is given. (auth)

7183

ON THE DECAY OF ^{62}Zn , ^{62}Cu AND ^{62}Co . R. H. Nussbaum, A. H. Wapstra, R. van Lieshout, G. J. Nijgh, and L. Th. M. Ornstein (Instituut voor kernfysisch onderzoek, Amsterdam, Netherlands). *Physica* **20**, 571-2(1954) Aug. (In English)

Preliminary results of the investigation of the decay of Zn^{62} , Cu^{62} , and Co^{62} are summarized. The following conclusions were drawn. The Cu^{62} - Ni^{62} mass difference is 3.93 ± 0.01 Mev, which gives a difference of the Cu^{62} and Ni^{62} mass defects of 1.815 ± 0.054 mmu. The relative intensity of the 1.17-Mev γ ray in Co^{62} indicates it is the transition from the first excited state in Ni^{62} . The ground state and the first excited state in Cu^{62} are restricted to a spin 0 or 1, even parity. (J.S.R.)

THEORETICAL PHYSICS

7184

Carnegie Inst. of Tech.

RESEARCH AND DEVELOPMENT ON QUANTUM ELECTRODYNAMICS. TECHNICAL REPORT NO. 2 [FOR PERIOD] JANUARY 1, 1953 THROUGH JUNE 30, 1954. [THE DISPLACEMENT OF THE GROUND STATE ENERGY OF A MU-MESIC ATOM DUE TO NUCLEAR DISTORTION (thesis)]. Wilbur Lakin. 65p. Contract [DA-36-061-ORD-322]. (NP-5352)

7185

CONSERVATION OF ISOTOPIC SPIN AND ISOTOPIC GAUGE INVARIANCE. C. N. Yang and R. L. Mills (Brookhaven National Lab., Upton, N. Y.). *Phys. Rev.* **96**, 191-5(1954) Oct. 1.

It is pointed out that the usual principle of invariance under isotopic spin rotation is not consistent with the concept of localized fields. The possibility is explored of having invariance under local isotopic spin rotations. This leads to formulating a principle of isotopic gauge invariance and the existence of a b field which has the same relation to the isotopic spin that the electromagnetic field has to the electric charge. The b field satisfies nonlinear differential equations. The quanta of the b field are particles with spin unity, isotopic spin unity, and electric charge $\pm e$ or zero. (auth)

7186

BOUND STATES AND THE FORMAL THEORY OF SCATTERING. M. N. Hack (Princeton Univ., N. J.). *Phys. Rev.* **96**, 196-8(1954) Oct. 1.

The exact expression for the transition rate for quantum-mechanical scattering problems is derived formally without recourse to adiabatically switching on the interaction or averaging the initial state in time. The equivalence is shown of the stationary definition of the S matrix and an appropriate definition by the time-dependent method. (auth)

7187

GENERALIZED VARIATIONAL PRINCIPLE FOR THE SCATTERING AMPLITUDE. S. I. Rubinow (Massachusetts Inst. of Tech., Cambridge). *Phys. Rev.* **96**, 218-19(1954) Oct. 1.

The Schwinger variational principle in differential form

for the S-wave phase shift has been generalized so as to be applicable to the entire scattering amplitude. (auth)

7188

VACUUM POLARIZATION IN A STRONG COULOMB FIELD. Eyvind Wichmann and Norman M. Kroll (Columbia Univ., New York). *Phys. Rev.* **96**, 232-4(1954) Oct. 1.

A new attack on the polarization charge problem is presented, utilizing techniques which either avoid power series expansions in certain quantities, or which establish the convergence of the power series. It is observed that corrections for the polarization potential $V(r)$ of the Uehling formula are small, so the use of this formula for the μ -meson work appears to be well justified. (L.M.T.)

7189

ON A RELATIVISTIC THEORY OF THE INTERACTION OF NUCLEONS. I. E. Tamm, V. P. Silin, and V. Ya. Fainberg. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, No. 1, 3-13(1953). (In Russian).

It is shown that a relativistic treatment of two nucleons interacting through a pseudoscalar meson field with pseudovector coupling does not alter a previous conclusion about the instability of the system because of the pole at $r = 0$. The potential obtained from second-order perturbation theory is considered. In another section, the work of Levy concerning pseudoscalar mesons with pseudoscalar coupling is considered. It is shown that his conclusions of no binding and infinite energy for the two-nucleon system are incorrect. (Science Abstracts)

7190

ON THE THEORY OF MESON FIELDS. I. VECTOR FIELD OF GENERAL TYPE IN THE VACUUM. A. A. Borgardt. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, No. 1, 24-32 (1953). (In Russian).

This paper constitutes a formal study of the noncommutative algebra formed by the Duffin-Kemmer β -matrices in their reducible representation. These matrices are used in wave-equations for particles with integer spin. The equations are cast in such a form that supplementary conditions are not necessary. Field variables are related to canonical variables. (Science Abstracts)

7191

ON THE THEORY OF MESON FIELDS. II. FIELD WITH SOURCES. A. A. Borgardt. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, No. 3, 284-92(1953). (In Russian).

Equations of motion are obtained from the 16-dimensional equation of Pt I. Various invariants are formed from the matrices of the algebra and related to physical quantities. The theory of neutral quanta of integer spin is considered in detail, especially in the limit of zero self-energy. A perturbation theory is formulated. (Science Abstracts)

7192

QUANTUM ELECTRODYNAMICS IN CONFIGURATION REPRESENTATION. III. INTERACTION OF ELECTRONS AND POSITRONS WITH THE ELECTROMAGNETIC FIELD. Yu. M. Shirokov. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, No. 2, 135-49(1953). (In Russian).

The fields described in Pts I and II are treated in the same spirit here, but with a coupling term which allows a

description of annihilation of two positive energy particles. The formulation contains nothing essentially new, being equivalent with formulations in momentum space. (Science Abstracts)

7193

QUANTIZATION OF FIELDS OBEYING EQUATIONS WITH HIGHER DERIVATIVES. I. A. V. Gurevich. *Zhur. Eksptl'. i Teoret. Fiz.* **24**, No. 2, 149-66(1953). (In Russian).

Wave equations of the type $P_n(\square)\Psi = -4\pi\rho$ (where \square is the D'Alembertian and P_n signifies a polynomial of order n) are discussed. A Hamiltonian method is developed for these field equations and quantization is carried through. The connection between such equations and equations describing particles with higher spin is discussed. (Science Abstracts)

7194

THE GREEN FUNCTIONS IN THE MESON THEORY WITH WEAK PSEUDOSCALAR BONDS. A. A. Abrikosov, A. D. Galanin, and I. M. Khalatnikov. *Doklady Akad. Nauk S.S.S.R.* **97**, 793-6(1954) Aug. 11. (In Russian).

Green's functions are utilized to remove divergences from the theory of pseudoscalar mesons with weak pseudoscalar interactions. (J.S.R.)

7195

ON THE REPULSION BETWEEN NUCLEONS. G. Szamosi (Zentralforschungs-Institut für Physik, Budapest, Hungary). *Naturwissenschaften* **41**, 369(1954) Aug. (In German).

Equations for the kinetic energy of nucleons were derived by treating the nucleus in the ground state as a Fermi gas at the absolute zero point. (J.S.R.)

7196

ISOBARIC SPIN AND THE HYPOTHESIS OF THE CHARGE INDEPENDENCE OF NUCLEAR FORCE. G. I. Zel'tser. *Uspekhi Fiz. Nauk* **53**, 455-500(1954) Aug. (In Russian).

URANIUM AND URANIUM COMPOUNDS

7197

PARAMAGNETIC RESONANCE IN URANIUM SALTS. S. N. Ghosh, Walter Gordy, and D. G. Hill (Duke Univ., Durham, N. C.). *Phys. Rev.* **96**, 36-8(1954) Oct. 1.

Paramagnetic resonance has been observed in U^{+3} and U^{+4} ions in powdered samples of UF_3 and UF_4 , respectively. The resonance curve in UF_3 was found to be asymmetric, with two unresolved peaks yielding $g_1 \approx 2.1$ and $g_2 \approx 2.8$. The resonance is broad and weak; the over-all half-width is about 5 kilogauss at room temperature. The curve obtained for UF_4 is symmetric and yields $g = 2.1$. Its half-width is about 3.5 kilogauss at room temperature. Although the resonance in UF_3 appeared somewhat stronger at liquid air than at room temperature, that in UF_4 could be detected only at room and at elevated temperatures. The results favor the interpretation that the two unpaired electrons in U^{+4} are 6d electrons, that the crystalline field in UF_4 is essentially cubic, and that either the lowest component of the Stark multiplet is a nonmagnetic singlet or that the electrons have a high degree of antiferromagnetic alignment. The results on UF_3 show that the crystalline field has an axially symmetric component. (auth)